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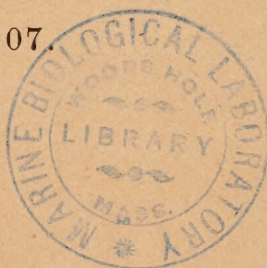
OF THE

SUPERINTENDENT

FOR

SUPPRESSING THE GYPSY AND
BROWN-TAIL MOTHS.

JANUARY, 1907.



BOSTON:

WRIGHT & POTTER PRINTING CO., STATE PRINTERS,

18 POST OFFICE SQUARE.

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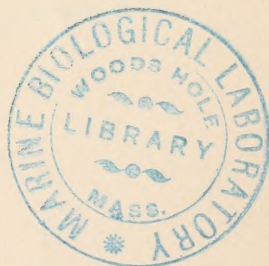
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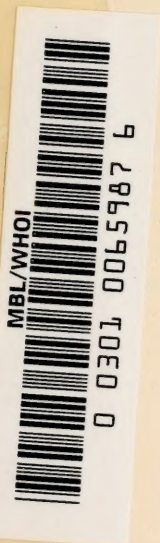


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APPROVED BY
THE STATE BOARD OF PUBLICATION.

Commonwealth of Massachusetts.

*To the Senate and House of Representatives of the Commonwealth of
Massachusetts.*

I present herewith for your consideration my second report as Superintendent for Suppressing the Gypsy and Brown-tail Moths. This report is submitted in accordance with the provisions of chapter 381, Acts of 1905, and contains a statement of the results accomplished to date, together with a record of expenditures and certain recommendations bearing on the future needs of the work.

A. H. KIRKLAND,
Superintendent.

BOSTON, Jan. 1, 1907.

ORGANIZATION.

A. H. KIRKLAND, M.S.,	.	.	<i>Superintendent.</i>
L. HOWARD WORTHLEY,	.	.	<i>Assistant Superintendent.</i>
JOHN A. FARLEY,	.	.	<i>Secretary.</i>
FRANK A. BATES,	.	.	<i>Field Agent, Southern Division.</i>
JOHN W. ENWRIGHT,	.	.	<i>Field Agent, Northern Division.</i>
CHARLES W. MINOTT,	.	.	<i>Field Agent, Western Division.</i>
GEORGE A. SMITH,	.	.	<i>Field Agent, Eastern Division.</i>

SCIENTIFIC STAFF.

C. H. FERNALD, Ph.D.,	.	.	<i>Consulting Entomologist.</i>
FRANKLIN H. MOSHER,	.	.	<i>Entomologist in Charge of Laboratory.</i>

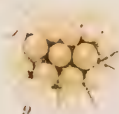
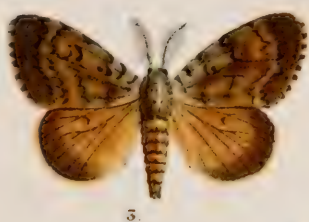
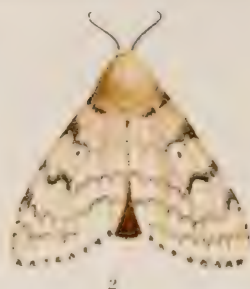


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EXPLANATION OF PLATE.

FIGS. 1 AND 2. — Female gypsy moths.

FIGS. 3 AND 4. — Male moths.

FIG. 5. — Pupa.

FIGS. 6 AND 7. — Caterpillars.

FIG. 8. — Egg cluster.

FIG. 9. — Eggs, magnified.

FIG. 10. — Single egg, greatly magnified.

(Used by permission of Massachusetts Board of Agriculture.)

Commonwealth of Massachusetts.

THE GYPSY AND BROWN-TAIL MOTHS.

In the first annual report of the Superintendent for Suppressing the Gypsy and Brown-tail Moths, submitted Jan. 1, 1906, a somewhat detailed history of the moths in Europe was given, and their introduction into Massachusetts, their escape and gradual spread, as well as the previous efforts of the State to suppress them, were outlined. For this information reference to the above report may be made. The former work of the Massachusetts Board of Agriculture and the beginnings of the present effort to suppress the moths early in the summer of 1905 were also described in full. It should be borne in mind that at the time the present State work against the moths began, the eggs had hatched and the caterpillars were already swarming in the trees; that the perfecting of an organization necessary to carry out the present law required much time and effort, and that but little in the way of effective measures could be accomplished in controlling the caterpillars during the season of 1905. The same was also true of the efforts to approximately determine the size of the infested district, — a problem which at this writing has not been definitely solved. While we know approximately the bounds of the area occupied by the gypsy and brown-tail moths, to determine accurately the limits of the infested district will require a larger expenditure than seems to the superintendent warranted under the present condition of State appropriations. These facts are cited merely to emphasize the fact that the report on the seven months' work of last year was in the nature of a preliminary one, and that only at the close of the summer of 1906 were we able to complete a full year's work against the moths.

The State work has gone far enough to reveal a most alarming state of affairs. The gypsy moth has been found spread throughout nearly all of eastern Massachusetts, many of the border towns in Middlesex and Worcester counties being infested, while the central towns are thoroughly infested from one end to the other. It is apparent that the State is called upon to make a most vigorous fight against one of the best-known and most important enemies of fruit and shade trees scattered throughout more than one-quarter of its area. The case is not at all comparable to that of the cotton boll weevil now ravaging the cotton fields of the southwest, which is restricted to a single food plant, nor to the outbreaks of insects like the chinch bug or Hessian fly in our western States, which feed on but few plants. While the gypsy moth has not caused important damage to field crops except in rare cases, it does attack the whole wide range of fruit trees, shade trees, forest trees and ornamental shrubs, and when unrestricted leaves only desolation and ruin in its path. It also naturally follows that wherever the pest finds lodgment, it obtains food on which it can thrive and develop, and within a few years increases into a colony of notable proportions.

With the developments of the last year and the experience gained, we are now able to present a much more accurate statement of existing conditions than was possible at the time of the presentation of the first report. As many of those interested in the progress of the unique co-operative effort to suppress the gypsy and brown-tail moths in Massachusetts will not be able to find time to peruse all the details of this report, it has seemed best to present the following summary of the same.

SYNOPSIS OF THE REPORT.

1. The area heavily infested by the moths has been determined, but the complete extent of the infested district is not yet known, nor will be until funds are available for extensive scouting operations.

2. In the known infested district local work against the moths has been organized and prosecuted vigorously. Two lines of effort have been followed. Some 8,000 miles of streets have been worked over and kept practically free from the caterpillars,

thereby largely preventing the farther spread of the gypsy moth. In upward of 90 per cent. of the residential districts both moths have been so well controlled that but little caterpillar damage was noticeable last summer. The woodlands are more severely infested by the gypsy moth than ever before.

3. In the enforcement of the law against these insects we have been greatly assisted by a general spirit of helpful co-operation on the part of city and town officials, and by citizens throughout the moth-afflicted district.

4. In a few localities the work has been seriously hampered by the complication of local politics or by apathy, and in some cases by open opposition on the part of city or town officials.

5. The work of importing beneficial parasites is progressing satisfactorily.

6. By sections 8 and 9 of chapter 381, Acts of 1905, provision is made for expenditures to May 1, 1907. Additional appropriations should be authorized applying to future operations against the moths until such time as they are brought under control. Recommendations are:—

(a) A suitable appropriation should be made for the uninterrupted continuation of the work against the moths over a period of at least three years. Similar provisions should be made for further investigation and importation of beneficial parasites.

(b) In computing municipal and individual assessments the valuations of the previous year should be used.

(c) The superintendent should be given authority to do the necessary work against the moths in such cities or towns as fail to provide the necessary appropriations or suitable organizations for carrying on the work, subject to the approval of the Governor. The proportional cost of the same, as fixed by law, with a proper additional allowance for the cost of management, should be charged against such municipalities, to be collected in the same manner as other State taxes.

(d) The superintendent should be given authority to take charge, at the expense of the State, of the work against the moths in certain public parks, cemeteries and other places of general resort, subject to the approval of the Governor.

FINANCIAL STATEMENT.

The act under which the work against the moth pests is being conducted requires the superintendent to "separate so far as is practicable the expenditures on work against the gypsy moth from those on work against the brown-tail moth in each city and town." Such a division of expenses is practically impossible to obtain. The work against both moths goes on at the same time, the same gang removing brown-tail webs and creosoting gypsy moth nests as a part of the daily winter routine. In spraying operations, as well as in other forms of field work, both insects are destroyed indiscriminately. Hence such a division of expenditure seems to be entirely out of the question.

It has been impossible to obtain from several cities and towns a complete record of their expenses under the act at the time of submitting this report. The following statement includes the records of expenditures for work performed previous to Jan. 1, 1907, so far as obtainable.

The balance carried forward from last year, namely, \$14,524.35, was practically all paid out during the month of January, 1906, in reimbursements to towns and cities which for various reasons had failed to submit their vouchers at the time of closing our books. For the same reason, the balance carried forward to the credit of 1907 operations is apparent rather than real, and will be practically disbursed during the month of January in payments to those towns and cities whose records are yet incomplete.

Balance from 1905,	\$14,524 35	
General appropriation for 1906,	150,000 00	
Special appropriation for 1906, June 14,	75,000 00	
		<hr/> \$239,524 35

Office expenses:—

Management,	\$5,000 00
Salaries of clerks,	2,681 82
Rent,	1,250 04
Stationery and postage,	815 56
Printing,	313 59
Experts,	507 95
Sundries,	1,250 55
Supplies and furniture,	244 20

Field expenses:—

Wages of employees,	\$27,584 09	
Travelling expenses of employees,	7,829 48	
Supplies,	135 70	
Sundries,	28 14	
Reimbursements to cities and towns,	171,038 74	
		<hr/>
		\$218,679 86
Balance Jan. 1, 1907,		<hr/>
		\$20,844 49

Parasite Appropriation.

The greatly increased number of foreign shipments of parasitic material, as compared with those of 1905, necessitated the provision of a large amount of apparatus and the employment of much expert assistance during the breeding season, together with large disbursements to foreign collectors. The total expenses incurred in this work during the year 1906 are given below:—

Balance Jan. 1, 1906,	\$7,894 91	
Appropriation, 1906,	10,000 00	
		<hr/>
		\$17,894 91
Expended in 1906:—		
Wages of employees,	\$2,761 48	
Travelling expenses,	755 74	
Rent,	180 00	
Supplies,	891 42	
Stationery and postage,	17 99	
Experts,	105 92	
Sundries,	379 01	
Importation of parasites,	5,671 83	
		<hr/>
		10,763 39
		<hr/>
Balance Jan. 1, 1907,		\$7,131 52

ANALYSIS OF TOWN EXPENSES.

Of the total amount expended by cities and towns receiving reimbursement from the State, there has been a considerable increase in the amount invested in tools and supplies, the largest items being power spraying outfits, insecticides, hose, ladders, axes, etc. The total amount spent in the 57 cities and towns

receiving reimbursement from the State to the amount of \$148,860.36 may be distributed as follows:—

Total amount spent,	\$315,215 61
Pay rolls,	\$260,971 68
Travel,	599 72
Rent,	206 09
Supplies,	48,068 74
Sundries,	3,039 24
Stationery and postage,	1,470 81
Printing,	859 33
	<hr/> \$315,215 61

FINANCIAL SUMMARY BY TOWNS.

The following table shows the required expenditure under the law, total expenditure and reimbursement of each city and town of the district infested by the gypsy moth during 1905 and 1906. The showing for 1905 includes all reimbursements on account of work done during that year, some of which had not been made at the time the last report of the superintendent went to press.

	1905.			1906.		
	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.
Abington, . . .	\$508 08	\$46 75	—	\$1,016 16	—	—
Acton, . . .	339 59	150 00	—	679 17	\$108 23	—
Amesbury, . . .	1,059 49	667 20	—	2,118 97	902 75	—
Andover, . . .	1,221 62	1,010 00	—	2,443 24	2,075 49	—
Arlington, . . .	1,978 25	10,484 57	\$6,805 06	3,956 49	14,983 35	\$8,821 49
Ashland, . . .	203 33	25 00	—	406 65	121 90	—
Avon, . . .	181 48	15 00	—	362 96	—	—
Ayer, . . .	333 94	—	—	667 87	—	—
Barnstable, . . .	969 31	—	—	1,938 62	150 00	—
Bedford, . . .	242 04	131 92	—	484 08	2,390 50	1,906 42
Belmont, . . .	1,105 21	4,396 51	3,291 30	2,210 42	5,203 53	2,993 11
Beverly, . . .	2,500 00	3,500 00	—	5,000 00	6,718 94	859 47
Billerica, . . .	439 47	—	—	878 94	1,984 39	1,105 45
Boston, . . .	2,500 00	4,798 56	1,149 28	5,000 00	15,613 96	5,306 98
Bourne, . . .	507 55	—	—	1,015 09	132 34	—

	1905.			1906.		
	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.
Boxborough, .	\$49 38	—	—	\$98 75	\$11 50	—
Boxford, .	203 60	\$319 54	\$115 94	407 19	1,088 19	\$681 00
Braintree, .	981 55	821 92	—	1,963 09	1,873 16	—
Bridgewater, .	614 16	23 00	—	1,228 32	272 53	—
Brockton, .	2,500 00	—	—	5,000 00	—	—
Brookline, .	2,500 00	919 48	—	5,000 00	—	—
Burlington, .	114 49	1,628 14	1,513 65	228 98	5,147 05	4,918 07
Cambridge, .	2,500 00	6,900 63	2,200 32	5,000 00	7,957 07	1,478 54
Canton, .	740 12	40 00	—	1,480 24	—	—
Carlisle, .	80 71	—	—	161 41	1,551 04	1,389 63
Carver, .	303 42	20 00	—	606 84	—	—
Chelmsford, .	617 55	450 00	—	1,235 09	2,207 73	972 64
Chelsea, .	2,500 00	1,806 59	—	5,000 00	—	—
Cohasset, .	1,281 46	500 00	—	2,562 89	2,058 00	—
Concord, .	1,098 01	—	—	2,196 01	4,190 94	1,994 93
Danvers, .	1,069 75	2,248 60	1,178 85	2,139 51	6,415 45	4,275 94
Dedham, .	2,159 65	93 75	—	4,319 29	638 28	—
Dover, .	185 61	8 00	—	371 21	823 00	451 79
Dracut, .	426 57	—	—	853 14	—	—
Duxbury, .	374 10	90 00	—	748 20	—	—
East Bridgewater, .	326 18	70 00	—	652 37	615 21	—
Easton, .	964 18	—	—	1,928 36	132 69	—
Essex, .	209 80	773 15	563 35	419 61	1,924 63	1,505 02
Everett, .	2,500 00	490 20	—	5,000 00	4,667 51	—
Framingham, .	1,843 72	300 00	—	3,687 44	3,438 54	—
Georgetown, ¹ .	195 86	107 90	—	391 72	—	—
Gloucester, .	2,500 00	2,171 32	—	5,000 00	4,724 35	—
Groveland, .	209 52	173 43	—	419 03	644 46	225 43
Halifax, .	63 11	10 00	—	126 21	34 50	—
Hamilton, .	560 38	1,306 10	500 00	1,120 77	2,472 01	1,351 24
Hanover, ¹ .	274 16	105 00	—	548 32	605 54	—
Hanson, .	149 30	60 00	—	298 60	—	—
Haverhill, .	2,500 00	785 70	—	5,000 00	1,391 36	—
Hingham, .	872 69	100 00	—	1,745 38	3,863 95	2,118 57
Holbrook, .	253 64	25 00	—	507 27	—	—
Holliston, .	310 23	—	—	620 45	—	—
Hopkinton, .	327 86	—	—	655 71	67 40	—

¹ These towns have not yet filed satisfactory returns for reimbursement.

	1905.			1906.		
	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.
Hudson, . .	\$626 41	\$150 90	—	\$1,252 82	\$349 83	—
Hull, . .	909 23	15 00	—	1,818 45	—	—
Hyde Park, . .	2,500 00	350 00	—	5,000 00	2,876 52	—
Ipswich, . .	743 19	1,184 89	\$441 70	1,486 38	3,527 33	\$2,040 95
Kingston, . .	283 29	50 00	—	566 57	—	—
Lakeville, . .	124 86	7 00	—	249 71	—	—
Lawrence, . .	2,500 00	—	—	5,000 00	—	—
Lexington, . .	1,165 46	3,990 52	2,825 06	2,330 92	10,217 11	7,886 19
Lincoln, . .	457 03	53 00	—	914 06	—	—
Littleton, . .	197 53	—	—	395 05	49 25	—
Lowell, . .	2,500 00	—	—	5,000 00	1,076 21	—
Lynn, . .	2,500 00	6,204 44	1,852 22	5,000 00	24,319 24	9,351 10
Lynnfield, . .	147 28	1,777 74	1,634 94	294 55	3,795 36	3,500 81
Malden, . .	2,500 00	4,782 71	1,141 36	5,000 00	13,298 00	4,149 00
Manchester, . .	2,030 05	1,121 57	—	4,060 10	2,619 86	—
Marblehead, . .	1,420 26	2,829 99	1,127 78	2,840 52	3,055 27	171 80
Marlborough, . .	1,895 80	—	—	3,791 60	2,239 43	—
Marshfield, . .	330 35	60 00	—	660 70	150 00	—
Maynard, . .	704 93	20 00	—	1,409 87	—	—
Medford, . .	2,500 00	12,684 89	5,092 45	5,000 00	18,285 18	6,642 59
Melrose, . .	2,500 00	6,945 29	2,222 65	5,000 00	13,555 12	4,481 06
Merrimac, . .	253 34	407 75	—	506 68	667 05	160 37
Methuen, . .	1,030 08	—	—	2,060 16	3,921 90	1,231 74
Middleborough, . .	826 29	30 00	—	1,652 57	—	—
Middleton, . .	129 19	624 00	494 81	258 37	1,336 11	1,077 74
Millis, . .	143 39	—	—	286 79	128 98	—
Milton, . .	2,500 00	585 26	—	5,000 00	—	—
Nahant, . .	1,064 15	230 00	—	2,128 30	—	—
Natick, . .	1,325 73	—	—	2,651 45	—	—
Needham, . .	808 24	105 97	—	1,616 48	1,383 48	—
Newbury, . .	239 36	549 33	309 97	478 72	2,500 04	2,021 32
Newburyport, . .	2,162 17	1,266 84	—	4,324 35	3,876 55	—
Newton, . .	2,500 00	1,231 36	—	5,000 00	8,277 49	1,638 75
North Andover, . .	891 65	805 00	—	1,783 29	965 45	—
North Reading, . .	133 73	238 55	104 82	267 47	1,029 17	761 70
Norwell, . .	167 46	85 00	—	334 91	—	—
Norwood, . .	1,025 55	15 00	—	2,051 09	—	—

	1905.			1906.		
	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.
Orleans, . .	\$116 72	—	—	\$233 44	\$90 00	—
Peabody, . .	1,748 97	\$5,253 54	\$2,803 66	3,497 94	8,551 41	\$4,042 78
Pembroke, . .	189 78	95 18	—	379 56	—	—
Plymouth, . .	1,869 74	—	—	3,739 47	600 00	—
Plympton, . .	66 24	25 00	—	132 48	—	—
Quincy, . .	2,500 00	1,023 97	—	5,000 00	6,129 25	564 63
Randolph, . .	399 05	15 00	—	798 10	—	—
Raynham, . .	148 17	—	—	296 33	88 55	—
Reading, . .	922 69	2,310 60	1,387 91	1,845 37	4,895 13	3,049 76
Revere, . .	2,439 45	3,994 77	1,244 26	4,878 89	3,505 39	—
Rockland, . .	659 09	250 00	—	1,318 18	575 45	—
Rockport, . .	614 54	688 11	73 57	1,229 08	1,234 79	5 71
Rowley, . .	148 78	248 73	99 95	297 56	1,064 66	767 10
Salem, . .	2,500 00	5,602 22	1,551 11	5,000 00	11,453 52	3,226 76
Salisbury, . .	170 50	762 19	591 69	340 99	1,978 20	1,637 21
Saugus, . .	866 77	8,922 25	8,055 48	1,733 54	15,522 71	13,789 17
Scituate, . .	701 91	110 00	—	1,403 93	280 75	—
Sherborn, . .	178 90	40 00	—	357 80	957 88	600 08
Somerville, . .	2,500 00	1,100 00	—	5,000 00	5,855 04	427 52
Southborough, . .	283 92	100 00	—	567 84	337 61	—
Stoneham, . .	980 84	3,193 99	2,213 15	1,961 68	7,936 22	5,974 54
Stoughton, . .	636 46	282 00	—	1,272 92	—	—
Stow, . .	161 52	80 30	—	323 02	236 33	—
Sudbury, . .	236 52	75 00	—	473 04	397 89	—
Swampscott, . .	1,539 06	2,624 14	868 06	3,078 12	7,510 22	3,545 68
Tewksbury, . .	354 03	270 82	—	708 06	1,200 27	492 21
Topsfield, . .	190 24	626 45	436 21	380 47	1,258 44	877 97
Tyngsborough, . .	87 74	—	—	175 47	102 00	—
Wakefield, . .	1,669 12	3,881 74	1,770 10	3,338 24	4,945 01	1,285 42
Waltham, . .	2,500 00	1,197 64	—	5,000 00	7,709 81	1,354 91
Wareham, . .	658 31	25 00	—	1,316 62	—	—
Watertown, . .	2,431 91	4,099 24	1,333 86	4,863 82	7,703 99	2,272 14
Wayland, . .	382 54	10 00	—	765 08	944 45	179 37
Wellesley, . .	2,221 43	246 41	—	4,442 85	2,469 34	—
Wenham, . .	420 40	1,043 45	623 05	840 80	2,818 13	1,977 33
Westborough, . .	596 53	—	—	1,193 07	—	—
West Bridgewater, . .	223 24	15 00	—	446 48	—	—

	1905.			1906.		
	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Reimburse- ment.
Westford, . .	\$319 50	—	—	\$639 19	—	—
West Newbury, .	208 52	\$660 64	\$452 12	417 04	\$1,302 87	\$885 83
Weston, . .	1,099 50	254 48	—	2,199 00	5,225 29	3,026 29
Westwood, . .	415 96	50 00	—	831 93	7 62	—
Weymouth, . .	1,413 07	175 00	—	2,826 15	3,745 61	735 57
Whitman, . .	787 16	60 00	—	1,574 32	—	—
Wilmington, . .	245 50	—	—	491 00	2,785 28	2,294 28
Winchester, . .	2,058 73	3,379 16	1,056 34	4,117 46	14,056 96	7,951 60
Winthrop, . .	1,784 37	525 00	—	3,568 74	1,655 17	—
Woburn, . .	2,167 67	7,528 87	2,895 43	4,335 34	6,483 12	1,718 22
Yarmouth, . .	363 20	—	—	726 40	100 00	—

ALLOTMENTS OF THE APPROPRIATIONS.

Under a literal interpretation of the law providing for work against the gypsy and brown-tail moths, no provision is made for limiting the amount to be expended by any city or town upon which a reimbursement may be claimed from the State. As it was apparent that even a few towns having low liabilities might, if so disposed, use up the entire appropriation made for the benefit of the whole infested district, it was decided, after a conference with the Attorney-General and the State Auditor, that, in order to carry out the obvious intent of the law and to secure a reasonable and just division of State funds among the infested municipalities, it would be necessary to limit the expenditures upon which claims for reimbursement might be made. The adjustment of such allotments has been no small part of the work of this office. In each case, the allotment and consequent limitation of expense has been made first with reference to the local requirements of the work, and second with reference to the original financial liability of the city or town under the act. In all important cases the needs of the work were thoroughly canvassed by the superintendent, and a final sum fixed upon, after conference with the agent in charge of the district and frequently with city or town officials.

As might have been expected, we have encountered a notable dilemma in connection with these allotments. In certain cities required to expend \$5,000 before receiving reimbursement — communities often burdened with heavy debt — there has been a constant protest against expending the total sum necessary, in the opinion of the superintendent, to secure the desired degree of progress in controlling the moths. Further than this, in many cases, since any reimbursement to such cities would not be available until after the 1st of January following the expenditures, certain mayors have opposed the increase of indebtedness for running expenses under their direction, since the benefit of any State help would go to the credit of the succeeding administration, should they fail of re-election. While to those who give first place to the welfare of the public such a consideration seems small and unbusinesslike, it has in many cases been an important factor in preventing the proper supervision of funds for the work in hand.

On the other side of the question, many infested towns of low valuation, where after a nominal local expense the State has been called upon to assume all further cost of work, have shown a notable, and, as a whole, commendable desire to push the work with the utmost vigor, borrowing money to finance the same on short-term notes, and repaying it as reimbursements became available. To steer a clear course between these two widely divergent expressions of public opinion has required the utmost patience and care, and there is no doubt that errors have been made on both sides of the case; but the superintendent and his advisers have at all times endeavored to insist that the needs of the work should be met as fully as possible, and at the same time that no unwise or extravagant expenditures should be made.

Early in the year the available funds for 1906 were allotted as above indicated; and as soon as the additional appropriation of \$75,000 made by the last Legislature became available, further allotments were made. Late in the fall, when it was apparent that certain cities and towns would not expend their full quota, while others would be obliged to cease operations for lack of funds, various transfers of sums were effected between these two classes of towns, so that the work might be continued in all

localities. At the close of the year allotments of the appropriation available for 1907 — \$75,000 — were made, and the various town and city officials were notified.

HISTORY OF THE YEAR'S WORK.

Following the general policy which seemed wisest to the superintendent at the beginning of the work, — first, that of checking the spread of the gypsy moth, and second, that of relieving in the shortest possible time the greatest number of people from annoyance and damage by the caterpillar plague, — our operations during 1906 were practically confined to two lines.

It having been satisfactorily demonstrated in past years that the principal spread of the gypsy moth occurred through the dropping of the small caterpillars upon passing vehicles during May and June, an especial effort was made to keep the street trees throughout the badly infested central district free from the moth pest, and this in itself has been no mean task. Badly infested street trees have been the most important factor in the spread of the moth. So long as it was impossible to ride with carriage or automobile under such trees without picking up hundreds if not thousands of the tiny spinning caterpillars, so long was it impossible to prevent transportation of the insect to non-infested localities, while the danger of the distribution of the moth by such means within the known infested region has been equally great.

During the year 1906 there have been cleared of the moth pests and carefully attended, so far as figures reported by the local superintendents show, upward of 8,000 miles of streets, — a distance nearly equal to one-third of the circumference of the globe. Over this mileage of streets the shade trees have been cared for; cutting, burning and thinning operations, wherever necessary, have been carried on; and these have been followed by burllapping and spraying wherever the needs of the work have demanded. By a vigorous prosecution of the work on the street trees we feel that we have checked from 80 to 90 per cent. of the spreading of the moths. It is only fair to state, however, that, had larger appropriations been available, much more could have been done along this line.

The second line of effort was to relieve, as far as possible, the badly infested residential sections of the moth-infested district. It seemed best to the superintendent to endeavor to give the greatest possible measure of relief to the largest number of citizens within the shortest period of time, and to this end an effort was made to enforce vigorously the requirements of the law in the thickly settled districts. Having cleared street and other public trees of the moth pests early in the year, the towns in these sections took up the work of cleaning private estates of eggs of the gypsy moth and nests of the brown-tail moth. This work was practically completed by May 1, with the exception of one or two cities which failed to comply fully with the requirements of the law. The most conspicuous example of failure to carry out fully the requirements of the statute was at Salem, where, notwithstanding the earnest protest of the superintendent, funds were not made available for the thorough enforcement of the law in the matter of work on private estates. As a result, during the larval season these neglected estates yielded swarms of gypsy moth caterpillars, which, spreading outward, attacked the shade trees on the streets, and thus caused to be undone the very efficient work which had previously been performed against the moths on the public streets. It is impossible to keep trees on streets clear from the moths unless the law is properly enforced on private estates which abut on the same. The condition of affairs at Salem is cited as an illustration of the interdependence of the work against the moth pest by the municipality and that done by private citizens, and as showing that, unless the law can be properly enforced on private estates, it avails but little to go to the expense of cleaning the adjoining street trees.

It was possible to secure a vigorous enforcement of the law as applied to private estates throughout about 90 per cent. of the thickly settled sections of the moth-infested district. Property owners were instructed in the proper methods of work, and when it became generally understood that the provisions of the law were to be enforced, an enormous amount of private estate clearing was accomplished. Aside from the direct operations of creosoting gypsy moth nests and cutting and burning brown-

tail webs, much help was gained by the general cutting of hollow, diseased and worthless trees and of brush which served as hiding places for the moths. It was not possible to have a general cleaning up of all estates in the residential district, but there has been a most satisfactory beginning along this line. Many property owners, being unable to attend personally to the details of the winter work, employed contractors; while others preferred to have the work done by the local forces, to be later paid for in the form of direct taxes.

Following the winter work, a great deal of banding of trees with sticky material or with burlap was done. By the time the bands were on, the spraying season opened; and in all towns which could be induced to purchase suitable apparatus, great gain was made in reducing the numbers of the moths by this means. The results of this general co-operative campaign against the moths, involving, as it did, a force of upward of 1,200 employees and the assistance of many thousands of property owners, were apparent as the caterpillar season reached its height. For the first time in several years the citizens of our principal residential districts passed through the summer without notable annoyance from the caterpillar pest, or without serious injury to their property. There were, of course, cases here and there in the district where the work had been neglected or poorly done and where small outbreaks developed; but by far the large majority of our citizens received the protection from caterpillar annoyance and injury which they had anticipated, — a result most gratifying, and promising well for the future. It is not too much to say that, with the thorough testing which the present law against the moths has received, it is apparent that it provides an effective means for bringing the insects under control wherever a general co-operation can be secured.

While as above stated the results in the fields in which we have worked are all that could be desired, we are obliged to report with regret that in the woodlands, which perforce were practically neglected during the season, the insects made gains. Several thousands of acres of low-cost woodland were stripped by the caterpillars, and a notable extension of area took place in nearly all the woodland colonies. This is a matter which will be more fully

discussed at another point; but it is well to indicate that no permanent headway can be made against the moths so long as these woodland colonies remain as sources of infestation.

Following the spraying season the field forces were put at work attending the burlaps, with good results. From June to August a part or the whole of the local forces were engaged in crushing the caterpillars beneath the bands and under the burlaps, and in destroying pupæ. In the past it has been the policy to allow the gypsy moths to emerge from the pupæ and deposit their eggs before renewing the battle against them. Instead of continuing this method, it seemed best to the superintendent to employ the men at the close of the caterpillar season in crushing pupæ by means of wire brushes attached to poles; and in all thickly infested districts this practice gave excellent results. Large numbers of the moths while on the egg masses were also destroyed by means of creosote, and then the forces were transferred to the work of treating the nests on the trees from the ground up above the probable snow line. By October 1 the ground work, so called, was practically completed; and then efforts were directed to cutting out infested roadsides, and in some cases thinning belts of infested woodland adjoining roads. There was a gradual reduction of the forces from August to November 1, at which date the winter cleaning of street trees was begun, and is now in progress. The number of men actually engaged in destroying the moths under the direction of this office varied from 250 to 1,200, the maximum number being employed in the late winter and early spring of 1906. At the present time nearly 1,000 men are engaged in our field work, which number does not include the forces employed by the United States Department of Agriculture, Metropolitan Park Commission and other State boards, or Gen. S. C. Lawrence's employees at Medford.

The superintendent is glad at this point to acknowledge the help he has received from others interested in the work. The advice of the Honorable Attorney-General, the Auditor of the Commonwealth and the secretary of the Board of Agriculture have been freely sought and as freely given. The suggestions of the officials and several members of the Massachusetts Asso-

ciation for the Suppression of Gypsy and Brown-tail Moths have also been timely and most helpful. In matters of business policy the sound judgment and knowledge of practical field work against the moths of Gen. S. C. Lawrence of Medford have been of especial help; and, finally, the superintendent is glad to acknowledge his obligation to Assistant Superintendent L. H. Worthley, Secretary J. A. Farley, and Field Agents F. A. Bates, J. W. Enwright, C. W. Minott and G. A. Smith. These men, charged with the performance of responsible duties, have continued to serve the interests of the State with fidelity, and efficiency, and to them in no small measure is due the credit of whatever degree of success has been attained this year. Thanks are also due to the local superintendents in the various cities and towns and to the inspectors employed by the central office for hearty co-operation and faithful service.

EXTENT OF INFESTED TERRITORY.

It may be well to state at the outset that the actual limits of the district infested by the gypsy moth in Massachusetts are not yet known, and will not be determined until such time as funds for a thorough examination of the outlying towns by trained men are available. To correctly delimit the infested district, a force of at least 100 trained men might well be employed throughout the greater part of an entire year. Such operations, however, have so far been impossible, in view of the great need of suppressing the moth in the badly infested central district. It has not seemed wise to spend largely of our limited appropriations in scouting operations, while in the central infested towns there has been an opportunity to destroy the moths by millions, and thus relieve a large part of our suburban population from caterpillar annoyance and damage to trees.

The preliminary scouting operations have revealed alarming conditions. The gypsy moth has been found scattered over most of the eastern part of Massachusetts, some of the outlying towns in Middlesex and Worcester counties being generally infested, while the central towns of the district are thoroughly and heavily infested.

The case of the gypsy moth presents certain features not here-

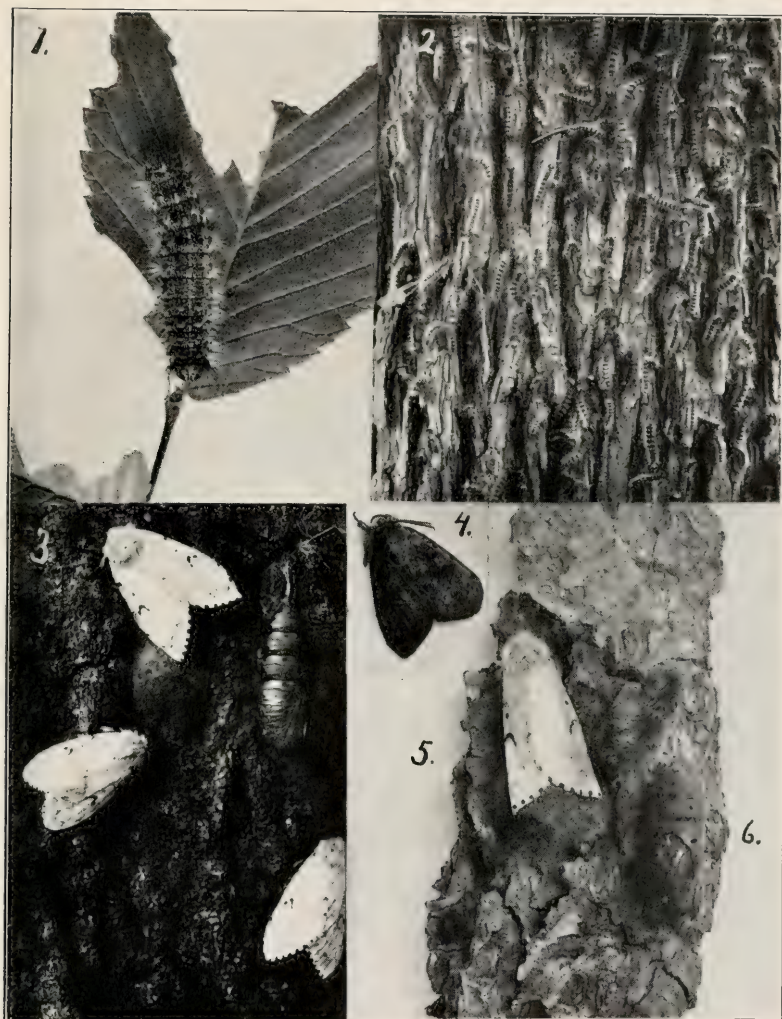


Fig. 1. Gypsy moth caterpillar feeding on elm leaf. Fig. 2. Gypsy moth caterpillars clustered on elm. Figs. 3 and 5. Female gypsy moths laying eggs (reduced). Fig 4. Male gypsy moth. Fig. 6. Pupa case from which moth has emerged.

tofore recognized in combating other insects injurious to agriculture and forests. It attacks the wide range of fruit trees, shade trees, forest trees and ornamental shrubs which may be grown in the temperate zone. Further than this, from the known distribution of the moth, occurring as it does throughout middle and southern Europe, western Asia and northern Africa, it is apparent to the entomologist that under favorable circumstances it might establish itself throughout the entire United States. It occurs from Stockholm on the north to Algiers on the south, from England on the west across the Altai Mountains to China and Japan on the east, while Neitner records specimens which were taken in Ceylon. It is a fair statement that this dangerous pest of fruit trees will flourish wherever the apple and pear can be grown; and the same is also true of the brown-tail moth. It therefore naturally follows that wherever either the gypsy or the brown-tail moth may find lodgment within the United States it may there find food on which to thrive and develop, and in comparatively few years increase into a colony of notable size.

During the past year, with the approval of His Excellency the Governor, there have been organized a few small scouting gangs for the careful inspection of localities in which it was thought the gypsy moth might occur; and unfortunately the results of the inspections so made to date have revealed the presence of the moth in a number of towns outside the infested district known in 1905. All told, 25 of the towns known to be infested in 1905 have been inspected by these gangs with the assistance of the local authorities, and in addition 16 municipalities lying outside the border of the 1905 infested district have been examined and found infested, viz.: Lowell, Dracut, Tyngsborough, Westford, Groton, Littleton, Ayer, Harvard, Boxborough, Westborough, Holliston, Millis, Easton, Raynham, Sandwich and Orleans. The work of scouting is still in progress, and will no doubt result in adding to the known infested district. As a matter of fact, the scouting of outside territory is a matter which will, under present or probable appropriations, require several years for its completion; and no doubt during the coming year more towns will be added to the list of those known to be

infested by the gypsy moth. Worcester, Gardner, Fitchburg, Northampton, Holyoke, Springfield, Pittsfield, Lenox and Stockbridge are all places particularly liable to infestation, and should be kept under constant surveillance. From the topographical situation of Worcester, and the immense amount of automobile travel passing through the city in the summer months, we have been most anxious lest the gypsy moth should find lodgment there. A limited amount of scouting was done in the city in 1905, and during the latter part of August and early in September, 1906, 5 inspectors from this office scouted the residential district over a two-mile radius from City Hall. Although this work was done while the leaves were still on the trees, it is safe to say that had any important colonies of the moth existed they would have been discovered. We are glad to state that no moths were found, as a result of this inspection; but Worcester should be kept under constant surveillance, particularly the easterly side toward Shrewsbury, along the main road leading to Marlborough.

Compared with the returns presented in last year's report, we now have 140 infested cities and towns as against 124, or 2,583 square miles of infested territory as against 2,224, in 1905. In considering these figures it should be borne in mind that the inspection of 1905 was necessarily restricted to a somewhat hasty examination of roadsides and orchards by a few trained men. Since it has now been possible to make thorough examinations of what may be called "sample" towns, both within and without the 1905 district, we are able to deduce conclusions of importance, although of a somewhat discouraging nature. It is apparent that the borders of the infested territory, not definitely known in 1905, will not be determined until sufficient money can be spent in thorough scouting operations. It is equally apparent, from the very large number of infestations found within the border of the 1905 district, that the gypsy moth is much more numerous in these towns than was suspected, and that a great deal of careful work will be required here. The worst of it all is, that these somewhat extensive infestations occur in towns which are practically non-revenue-yielding under the act, where the State must bear the principal cost of further exterminative work.

Equally unfortunate in this connection is the discouraging condition of those woodlands which were known to be slightly infested last year. In places like Gloucester, Topsfield, Middleton, Dedham and Wellesley the woodlands are known to be scatteringly infested, "peppered" (to use the phrase common among the local superintendents), as it were, here and there with small colonies, whose suppression will require a considerable outlay of money. Yet, on the other hand, if these slight infestations are neglected, their increase to dangerous proportions will be but a matter of a few years. These woodlands occur as a rule in towns of low valuation, which will require much financial aid from the State. The complete list of cities and towns infested by the gypsy moth Jan. 7, 1907, is given below:—

Abington.	Concord.	Kingston.
Acton.	Danvers.	Lakeville.
Amesbury.	Dedham.	Lawrence.
Andover.	Dover.	Lexington.
Arlington.	Dracut.	Lincoln.
Ashland.	Duxbury.	Littleton.
Avon.	East Bridgewater.	Lowell.
Ayer.	Easton.	Lynn.
Barnstable.	Essex.	Lynnfield.
Bedford.	Everett.	Malden.
Belmont.	Framingham.	Manchester.
Beverly.	Georgetown.	Marblehead.
Billerica.	Gloucester.	Marlborough.
Boston.	Groton.	Marshfield.
Bourne.	Groveland.	Maynard.
Boxborough.	Halifax.	Medford.
Boxford.	Hamilton.	Melrose.
Braintree.	Hanover.	Merrimac.
Bridgewater.	Hanson.	Methuen.
Brockton.	Harvard.	Middleborough.
Brookline.	Haverhill.	Middleton.
Burlington.	Hingham.	Millis.
Cambridge.	Holbrook.	Milton.
Canton.	Holliston.	Nahant.
Carlisle.	Hopkinton.	Natick.
Carver.	Hudson.	Needham.
Chelmsford.	Hull.	Newbury.
Chelsea.	Hyde Park.	Newburyport.
Cohasset.	Ipswich.	Newton.

North Andover.	Salisbury.	Watertown.
North Reading.	Saugus.	Wayland.
Norwell.	Sandwich.	Wellesley.
Norwood.	Seituate.	Wenham.
Orleans.	Sherborn.	Westborough.
Peabody.	Somerville.	West Bridgewater.
Pembroke.	Southborough.	Westford.
Plymouth.	Stoneham.	West Newbury.
Plympton.	Stoughton.	Weston.
Quincy.	Stow.	Westwood.
Randolph.	Sudbury.	Weymouth.
Raynham.	Swampscott.	Whitman.
Reading.	Tewksbury.	Wilmington.
Revere.	Topsfield.	Winchester.
Rockland.	Tyngsborough.	Winthrop.
Rockport.	Wakefield.	Woburn.
Rowley.	Waltham.	Yarmouth.
Salem.	Wareham.	

CONDITION OF INFESTED DISTRICT.

A description of the infested district gives opportunity for a natural division between the central and the outer towns and cities. By the "central towns" are meant those comprising the principal, central, badly infested district, which includes all those cities and towns known to be infested in 1899, with a slight extension of the border as the gypsy moth spread outward. In all these towns the street trees and residential districts are generally infested, although the numbers of the moths have been greatly reduced. The woodlands in these towns are in a very serious condition, and here the principal stripping took place in the summer of 1905.

The term "outer towns" includes those lying outside of this badly infested central district. Here the infestation varies in point of severity from those towns where small gypsy moth colonies may be located on nearly every street and in all the principal woodlands, to the border towns where diligent search by trained men was required to determine the presence of the moth.

In the case of each town the name of the local official in charge of the work is given, although in a few places the responsibility

has been placed in the hands of a board or commission, who have placed the immediate field operations in charge of a foreman.

Central Towns.

ARLINGTON.

W. H. BRADLEY, *Local Superintendent.*

The vigorous campaign against the gypsy moth inaugurated in this town last year has been carried on with undiminished vigor, has been well directed, and has at all times been heartily supported by town officials and citizens alike.

The winter work against the moth having been completed early in May, the trees of the principal streets were banded with Tanglefoot, and all street trees were sprayed. At Arlington Heights much spraying was done in certain badly infested woodlands, in order to protect the residential district, where the property owners had shown a most commendable desire to clear their trees of the moths. Burlapping was generally followed throughout the town, with good results, while the spraying proved highly effective.

Menotomy Rocks Park, which last year was a most serious problem, received constant attention, the trees being banded with Tanglefoot and burlapped, and the ground burned over with oil. This latter operation, which at the time caused some local criticism, was necessary because of the thousands of broken egg-clusters scattered among the rocks and ledges; and the results, by a fall inspection, have shown the wisdom and economy of this method. While the park has suffered most severely in past years and as a consequence many of the trees have died, as a result of the vigorous measures there employed it is now in good condition as regards the moth pest. It will require constant attention for some years to come, but the cost of future work has been greatly reduced, and the park saved to the town.

After the caterpillar season the local force was reduced to 18 men, employed principally in removing dead trees from the park and in cutting brush on badly infested roadsides. An arrangement was made with a contractor to cut brush and

worthless trees and destroy the gypsy moth nests throughout the Sucker Brook valley from Mystic Street to Arlington Heights, thus destroying an extensive breeding place of the moth, which had proved in past years a constant source of infestation. The fall inspection shows a great improvement in the condition of the street trees and residential districts of the town, but an enormous amount of work yet remains to be done in the infested woodlands.

Plans for next year's work should consist in the continued care of street trees and residential districts, more extensive work in the Arlington Heights section, and, if possible, a beginning should be made in clearing the gypsy moth colonies from the easterly side of the town.

BELMONT.

A. W. ELSON, *Local Superintendent.*

The moth-work on private estates, as well as on street trees in the early part of the year, was performed by a contractor, and was in the main satisfactory. During the caterpillar season principal reliance was put upon spraying, which gave good results, although the use of burlap in the central part of the town would no doubt have reduced the cost of the fall and winter cleaning operations. Early in August the local superintendent organized a small force of men, which has been principally engaged in cutting brush along infested roadsides, cleaning the town trees, and in brush cutting and thinning operations in certain badly infested pasture land.

Notable improvement is apparent in the general condition of the street trees and private estates in the residential district, but the pasture and woodlands of this town still remain in a most serious condition, especially as regards the gypsy moth.

Much good work has been done on the property of the McLean Asylum, but much more remains to be done.

The hollow or worthless apple trees scattered throughout the town will require much attention in the way of cementing and tinning, while many of them should be cut and burned. There is very serious infestation on the northerly side of Marsh Street, extending toward the Arlington line, which should have attention as soon as funds permit.

A large tract of infested pasture land is held by Messrs. E. F. Atkins and H. O. Underwood, and co-operative work in connection with the town forces is now in progress on this property. The large amount of work which these gentlemen have done against the moths on their estates, not only in 1906 but in years previous, is worthy of highest commendation. Many other property owners in the town have shown a most helpful spirit of co-operation, and a marked gain has been made against the moths in the districts which have been worked over. The region around Little Spy Pond and the badly infested willows along Concord Avenue should receive attention at an early date. It is hoped that funds sufficient to attack the woodland problem may be available early in 1907.

This town has had the advantage, in its campaign against the moths, of the services of a practical business man, who has carried on the necessary operations vigorously and economically, and often at much personal inconvenience. To him is due in large measure the degree of success so far attained. Equally commendable has been the attitude of the town officials and hearty co-operation on the part of citizens.

The work next year should include a thorough burlapping of street trees and those on private estates, and a general campaign of spraying throughout the residential district. Spraying will also be necessary in woodlands adjoining the principal streets of the town.

BEVERLY.

JOHN W. LOVETT, *Local Superintendent.*

Early in February the work of clearing the moths from private estates was turned over to a contractor, who, from the large operations in which he was engaged elsewhere, was not able to give it as complete attention as he or this office desired. The natural result was, that at first the work was not done in a satisfactory manner, which necessitated inspection and reinspection on the part of the local authorities and employees of this office.

In May a limited amount of spraying was done on the street trees and on certain badly infested private estates. So far as winter and spring work on these estates is concerned, we do not

feel that progress commensurate with the outlay has been made.

During the summer the street trees were burlapped and thoroughly attended, large numbers of caterpillars being thus destroyed. In late summer the brush in badly infested localities was cut and burned, and these places put in good condition for next season's work. The entire woodland of the city was scouted during the fall, and two large gypsy colonies, one off Essex Street and one off Brimbal Avenue, were found. This inspection showed that the woodland as a whole was generally infested with scattering gypsy moth nests, and is indeed in a most serious condition. It will be necessary to expend a large sum of money in the woodlands if the moth is to be held in check there.

The condition of the residential section is decidedly better than that of 1906. At the present time the work of cleaning the street trees and destroying infested brush along roadsides is in progress.

It is only fair to say that in Beverly the mayor and the city government have shown at all times the most gratifying willingness to co-operate with this office in the work, and that the administration of the local superintendent has been highly satisfactory.

BOSTON.

D. HENRY SULLIVAN, *Local Superintendent.*

During the early part of the year the public grounds department, cemetery department and the school department cleared all trees under their charge of both species of moths. In April a force of 100 men employed by the park department made an effort to enforce the requirements of the law on private estates, but, owing to the lateness of the season, little was accomplished. The principal work done on private estates was at Brighton, East Boston and in part of Roxbury. No burlapping was done in the city, but during June a considerable amount of spraying was done by the park department, with generally good results. Owing to the serious neglect of private estates during the winter, there was an unfortunate outbreak of the

brown-tail moth in the early summer, and in certain sections very serious gypsy moth depredations occurred. The responsibility for this condition of affairs was principally due to the failure of the city to provide the necessary funds for a thorough campaign against the moths during the winter season.

When the time for fall work arrived, through the active co-operation of His Honor the mayor, suitable funds were provided for the enforcement of the law on private property; and a force of upward of 100 men has been engaged in clearing and destroying the gypsy and brown-tail moths on private estates. This work has been vigorously prosecuted, and, if it can be continued through the winter, should yield a large measure of relief to the most seriously infested districts.

Much yet remains to be done in the way of cutting worthless brush and dead trees in the outlying wards, where the gypsy moth occurs in numbers; and next season the general use of burlap and spraying should be followed.

There has been some decrease in the numbers of brown-tail moths in the city, and it is hoped that we shall soon be able to bring both insects under control in Boston.

BROOKLINE.

USIP PERIN, *Local Superintendent.*

This town is thoroughly infested by the gypsy moth, and, because of the large amount of ornamental shrubbery and many valuable shade trees, does not lend itself as readily to the use of wholesale methods as in the case of towns where real estate has a lower valuation. It results, therefore, that in Brookline we are practically restricted to the use of burlap, spraying, and the destruction of egg clusters by hand. The work of suppressing the moths, both on private property and on the streets, has been undertaken by the town without reference to the owner's liability. In this work much assistance has been given by public-spirited citizens, who have employed contractors to clear many of the principal estates. The use of the burlap at Brookline gave very satisfactory results in 1906, but the local situation is complicated by a large number of wooden tree-guards, which harbor the egg clusters of the gypsy moth.

Next season's work should include the general use of the burlap on all trees in the town, while considerable spraying will be necessary in certain districts.

BURLINGTON.

W. W. SKELTON, *Local Superintendent.*

Serious infestation of this town continues, although the numbers of moths have been greatly reduced on street trees and residential sections. In the woods the gypsy moth has increased in numbers, the colonies in the Cummingsville section being the most serious. In the woodlands which were thinned out and treated last year a notable gain has been made; those which were not so treated are in a worse condition at present than ever heretofore.

Work against the brown-tail moth early in the year was followed by the burlapping of trees in the gypsy moth colonies, and a limited amount of spraying was done with a hand outfit in the southern part of the town.

The work in this town has been ably managed, but large expenditures will be required here next year.

The purchase of a power sprayer is recommended.

CAMBRIDGE.

J. F. DONNELLY, *Local Superintendent.*

The work in this city during the past year has been carried on in a generally satisfactory manner, the largest number of men employed at any one time being 105. The residential districts during the early part of the year were cleared of the gypsy and brown-tail moths, and later on the important infested sections were burlapped, while a considerable amount of spraying was done on the worst-infested private estates. In the sections so treated the fall inspection shows not over 20 per cent. as many gypsy moths as in 1905; and, had it been possible to carry on this work in the entire city in the same manner, doubtless equally as good results would have been obtained.

The work of cleaning the street trees is now in progress, and we have assurances that this will be followed up by vigorous

enforcement of the law on private estates. The worst gypsy moth districts are in the vicinity of Baldwin and Kirkland streets, Norton's Woods, and a section between Massachusetts and Concord avenues from the Cambridge station to the Belmont line. This latter section includes a large area of swampy land, thoroughly infested, and which no doubt serves as a source of infestation for the adjacent residential districts. There is also an important infestation between Coolidge Avenue and the Charles River reservation. The work here as a whole has been well supported financially, although, as in the case of nearly all our cities, there has been a delay in providing funds at seasons when the work could have been prosecuted to the best advantage.

CHELSEA.

ALFRED L. MAGGI, *Local Superintendent.*

We are glad to record a notable gain made against the moths in this city. The work here has been well organized, well directed, and has received at all times the liberal support of the mayor and city government. Were it not for the probable danger of reinfestation from districts lying to the north, the gypsy moth could easily be stamped out in this city.

In the early part of the season the work of destroying the brown-tail moths was completed, and a general campaign of burlapping and spraying gave excellent results.

The fall inspection shows that there are not over one-half as many gypsy moths in Chelsea as in 1905, the principal colonies occurring in the section locally known as "Prattville," near the Everett line.

The general use of the burlap and some spraying will be required here in 1907.

DANVERS.

THOMAS E. TINSLEY, *Local Superintendent.*

This town is generally infested by the gypsy and brown-tail moths, the gypsy moth infestation on private property being of a most serious nature. Much efficient work and large expenditures will be necessary here in 1907 to keep the gypsy moth under control.

In January a large part of the private property was cleared of the moths by the local superintendent, and infested brush and trees cut in the badly infested localities. The serious infestation in Burley Street was treated in a most excellent manner. During the summer spraying was followed with good results, while all private and public trees were burlapped and thoroughly attended. A limited amount of scouting done this fall by Inspector F. C. Worthen showed a number of important woodland colonies of the gypsy moth which should be attended to during the coming year.

At the present writing the work of clearing the street trees and cutting and burning infested brush is in progress.

ESSEX.

OTIS O. STORY, *Local Superintendent.*

In the early part of January the work of destroying the brown-tail and gypsy moths on private property was commenced, with the discouraging result that nearly every orchard in town was found infested by the gypsy moth; some of these orchards are in very serious condition, and hollow trees there should be either cemented, or cut and burned. The trees on streets and in residential sections were burlapped and thoroughly attended during the summer, large numbers of caterpillars being found on private property.

If the gypsy moth is to be checked in Essex, much vigorous work will be necessary in the orchards next season, and spraying can be followed here to great advantage. Brush along infested roadsides has been cut and burned, but work of this class remains to be done on Apple Street and along the Manchester Road.

The woodlands are known to be infested in spots, and should be thoroughly scouted as soon as funds permit.

EVERETT.

WILLIAM KENNERLY, *Local Superintendent.*

This city is comparable to Chelsea in having no large wooded areas and being a thickly settled residential district. The local superintendent went over the town thoroughly early in the season, destroying both forms of moths, and doing an excellent

piece of work. The street trees throughout the town were burlapped and carefully attended, while spraying was done in the worst infested sections. The result of this work shows a reduction of the gypsy moth to a point where not over 25 per cent. as many egg clusters can be found as was the case in the fall inspection of 1905. It should not be inferred from the above that the city is reasonably free from the moth, since it occurs in scattered numbers over the entire area, and much careful work will be required in the future to keep it in check.

The most seriously infested section at present is in the Mount Washington district near the Chelsea line, along Elm Street near Woodlawn Cemetery, and near the Belmont Hill section of Malden. Much good work has been done in Woodlawn Cemetery, where a vigorous campaign has been carried on by the authorities in charge. Superintendent Marshall of the cemetery department has co-operated fully with the city and State authorities, and deserves much praise for the efficient manner in which he has succeeded in keeping the moth under control.

On the part of the city the work has received proper and liberal financial support. It will be necessary to use the burlap generally over the entire city next year, while a limited amount of spraying will also be required.

GLOUCESTER.

W. D. CORLISS, *Local Superintendent.*

The general infestation of Gloucester was noted in the last annual report. The trees on the streets and private estates throughout the entire city were burlapped and carefully attended with good results during the caterpillar season, while spraying in badly infested sections was notably effective.

As a result of the thorough work of the local superintendent, the street trees of this city are now in excellent condition, while considerable gain has been made in suppressing the moths on private estates. We have to report a general gypsy moth infestation of woodland, about two-thirds of which has now been scouted, and also the finding of two large and important gypsy moth colonies: on Essex Avenue near Haskell's Pond upward of 2,000 nests were found, while in the colony off Magnolia

Avenue, known locally as the "Heater-piece," between 10,000 and 15,000 nests have been destroyed. The finding of these large colonies has made necessary a considerable amount of cutting of brush and thinning of trees in preparation for next year's work.

The work of suppressing the moths in Gloucester has at all times had the hearty support of the city authorities, and it has been carried out in an efficient manner by the local superintendent.

The interest and spirit of co-operation shown by the large property owners is worthy of special commendation. At the present writing all street trees in the city have been cleaned of the moths.

LEXINGTON.

CORNELIUS WELLINGTON, *Local Superintendent.*

Lexington continues to offer one of the most serious problems in the moth-infested district. The town is generally infested from one end to the other by the gypsy moth, the woodlands being in particularly serious condition. The work here has been well supported by the local officials, has been carried on in the most excellent manner, and is worthy of all commendation. At the same time, much more could have been accomplished had sufficient funds been available when needed.

The residential sections and roadsides in the eastern half of the town were thoroughly treated, and in many cases a strip from 30 to 50 feet wide on private property adjoining the highway likewise received attention. In the important colonies stone walls and the ground were burned over by the use of an oil flame, while practically all the street trees and many badly infested orchards were sprayed with good results. Upward of 17,000 trees were burlapped and attended, while some 2,500 trees were banded with Tanglefoot. Large numbers of caterpillars were destroyed in their early stages beneath the burlap by the use of wire brushes,—an experiment which did not prove as efficacious against the larger caterpillars.

On Weburn Street, in the northern part of the town, where very serious colonies have existed, a strip approximately 100 feet wide on either side of the road has been thinned out and put

in good condition for the 1907 work. Wherever field work has been carried on during the past season a notable improvement is apparent; but it is only fair to state that large expenditures must be made in this town during the next few years, before the moth can be brought under control.

LYNN.

A. C. DOAK, *Local Superintendent.*

About February 1, arrangements were completed for a thorough campaign against the moths in this city, — a date altogether too late, in view of the general infestation existing here. Mr. Doak employed a large gang of men, and entirely covered the street trees and private estates in the residential district. A very general infestation was found, and, considering the short period of time available before the hatching season, the results of this work showed in an especially gratifying manner. The usual campaign of spraying and burlapping was vigorously prosecuted, with good results.

Lynn has been peculiarly exposed to continued infestation by the gypsy moth, because of the neglect of the large colonies existing in the Lynn Woods, which are now entirely and seriously infested. Hundreds of acres in these woods were stripped by the caterpillars during the past year, with the result that many fine pines, oaks and other trees have been killed. So severe was the caterpillar plague in this district last year that we were obliged to request the mayor to close the park to the public, which was done for a period of about two months.

Early in the fall an arrangement was completed between the Lynn park board and the Lynn water board and the State for special co-operative work, to reduce the pest in the Lynn Woods. The first effort to be made is naturally that of protecting the park roads, so as to reduce as far as possible the scattering of the caterpillars on vehicles. To this end upward of 100 men have been employed in thinning strips 75 feet wide along the principal roads, thus permitting of economical spraying operations next season; and this work is now organized in a satisfactory manner. The superintendent is strongly of the opinion that, unless a large sum of money can be expended in the Lynn

Woods during the next two years, the major part of the park will be irretrievably ruined. There is no section in the whole infested district more badly and generally infested than the Lynn Woods, and heroic measures will be necessary if any part of the reservation is to be preserved.

Too high praise cannot be given to the spirit of co-operation shown by His Honor the mayor and the city government in providing the funds for the commencing of this important work; and the same is equally true of the efficient and businesslike administration given the city by the local superintendent.

LYNNFIELD.

HENRY LAW, *Local Superintendent.*

During the early part of the year the local superintendent continued the work of clearing private estates from the moths, completing the same in residential sections before the hatching season. Early in May a large tract, where infested wood had been cut the previous year, was burned over, and some 60 acres of gypsy moth infestation done away with, the cost of burning being but \$1.30 per acre. All the street trees in the town were burlapped and attended during the caterpillar season, while considerable spraying was done in the southern part, with good results. Following the caterpillar season, the local superintendent commenced cutting or thinning infested trees and brush in the southern part of the town, near the cemetery road. Some 8 acres of woodland, very badly infested, have been entirely cut over, and 12 acres have been thinned out and put in condition for spraying. The ground here will be burned in the spring as soon as the caterpillars appear.

The work of cutting out infested roadsides has been prosecuted during the fall so far as funds would permit. While we have succeeded in keeping the street trees, and also the major part of the residential district clear of the moths, the woodlands remain very seriously infested by the gypsy moth. To treat them will require more money than is now available; but effort will be made to isolate these colonies so as to prevent the caterpillars from reaching the protected borders of the streets. It is apparent that in the course of a few years a very large part of

the pine timber at Lynnfield will fall a prey to the moths, and that the hard-wood growth will be very severely injured. At the same time, all that can be done under present conditions is to isolate the colonies.

At the present time the work of clearing the street trees and roadsides is in progress.

MALDEN.

GEORGE W. STILES, *Local Superintendent.*

Considering the conditions of Malden to-day when compared with those of 1905, it is apparent to any one familiar with the city that notable progress has been made in suppressing both moths. The work of the former local superintendent, Mr. Thomas W. Powell, was of the highest quality, and his preliminary efforts have been most ably seconded by the present local superintendent.

The condition of Malden is an example of the advantage of competent business management.

Early in the year there was a general enforcement of the provisions of the law on private estates, and this was followed by a vigorous burlapping and spraying campaign. In certain badly infested woodland districts, notably those along Salem Street, the underbrush and decayed trees were cut and burned to much advantage. The work along Highland Avenue and Border Road is equally commendable.

Next year's plan of work should include the general use of the burlap, together with much spraying in all badly infested districts.

MANCHESTER.

WILLIAM YOUNG, *Local Superintendent.*

The work of destroying the brown-tail and gypsy moths on private property was prosecuted vigorously during the early months of 1906, the gypsy moth being found particularly abundant along Summer, Pine and School streets. In the Pine Street colony the brush was cut, trees thinned, and the stone walls and ledges burned out with oil. This treatment gave very satisfactory results, since in this colony during the summer only two infested trees were found. The same methods were applied

to the School Street colony, and no caterpillars were found there during the summer. All the street trees and those standing on infested private estates were burlapped and the burlaps carefully attended during the summer, with satisfactory results. Strange to say, — at least from the standpoint of one familiar with the possible damage by the moth pest, — the local superintendent met with considerable opposition, in the work of burlapping private estates, on the part of several large property owners. It must be admitted that the burlap is to some extent unsightly; but stripped or dead trees as a result of gypsy moth damage are much more repugnant objects. If the work is to succeed in Manchester, property owners must co-operate fully with the town and State authorities; and it is to be hoped that the conditions above mentioned will not prevail in 1907.

The woodland has been thoroughly scouted by the local force, and two important gypsy moth colonies have been located, — one near the Essex line and the other on Pleasant Street. In the former upward of 5,000 nests were destroyed. The woodland is generally infested, while the street trees and residential sections show a great improvement over last year.

The work of inspecting and clearing the street trees is now in progress.

Manchester, because of its popularity as a summer resort, is particularly liable to infestation from outside sources; and, for the same reason, the moth infestations there should receive as thorough treatment as funds will permit.

MARBLEHEAD.

WILLIAM H. STEVENS, 2d, *Local Superintendent.*

The former local superintendent, Mr. N. Allen Lindsey, had a thorough inspection made of all private property in this town, finding numerous important gypsy moth colonies. During the season of 1906 these places were thoroughly sprayed, while a limited amount of spraying was done on the street trees. The latter, as well as trees on private property, were burlapped and attended during the summer, large numbers of caterpillars being destroyed. At the Curtis estate, where a serious colony had been discovered, it was necessary to cut and burn several large infested

willow trees, and this was followed by thinning operations in the fall months. This estate, with its badly infested stone walls, will require much attention next season, the plan of work involving a considerable amount of spraying and burning. While the street trees in Marblehead show an improvement over the past year, we are obliged to state that the condition of private estates is but little better than in 1906. The work done here by the local authorities has not been in all respects satisfactory, and the quality of it should be improved in 1907, if a net gain is to be made. The preliminary scouting of the woodland by Inspector W. A. Hatch having shown it to be generally infested, the local forces will during the winter months make a thorough examination of the same.

MEDFORD.

JOHN D. DWYER, *Local Superintendent.*

Notable progress has been made in the work against the gypsy moth on street trees and in the residential districts and to a considerable extent in the woodlands, which to-day show marked improvement over 1905. Early in the year a thorough campaign was made against both moths over the entire residential section, and some of the woodlands as well.

The burlap was generally used on all public trees, while the large amount of spraying done in the caterpillar season was equally satisfactory. After the eggs were laid, little work was done by the city until late fall, when considerable cutting was done in the woodland between Fulton Street, Highland Avenue and the Malden line. The thinning operations in Russell's woods, the so-called Syndicate Lot and the Dutton property last spring, if well followed up, would have doubtless shown good results the past summer; but for various reasons it seemed impossible to carry on the necessary burning, spraying and bur-lapping operations. The most unfortunate feature of the whole season's work in Medford was a serious neglect of the Medford water board property, lying between Forest and Elm streets. Here nothing was done until long after the gypsy eggs hatched, and the caterpillars stripped most of the trees. At the height of the caterpillar season protective belts were sprayed along the roadsides, and bands of oiled hay laid to prevent the in-

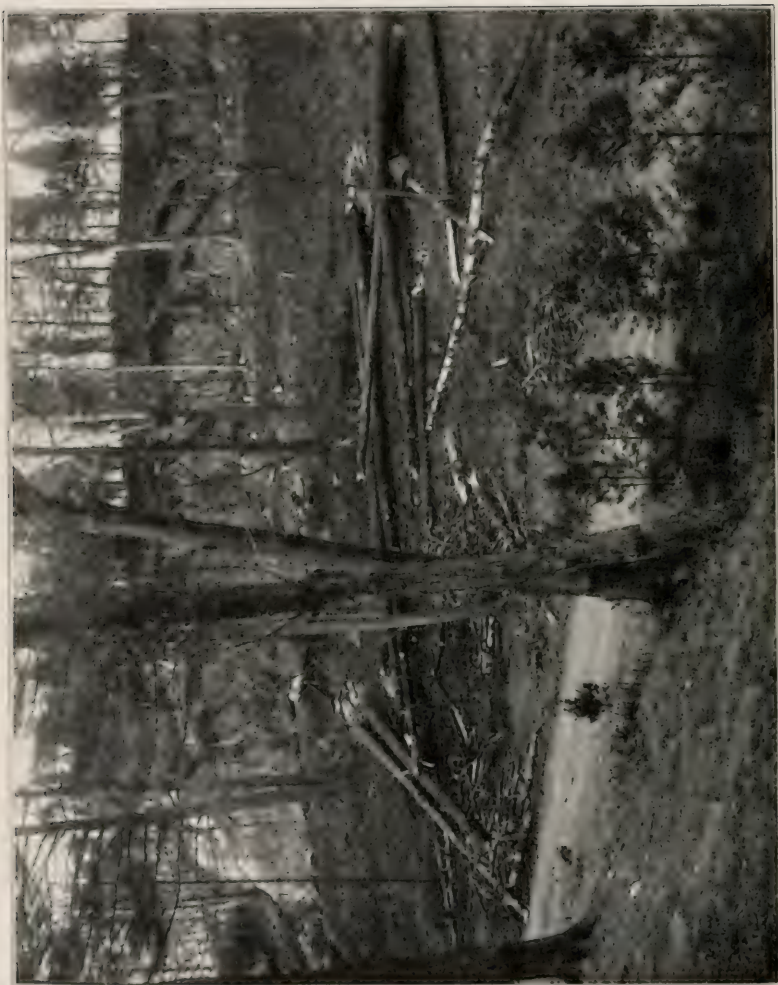
sects from passing on to adjacent property clear of the moths. This latter expedient was not wholly successful.

The work against the moths in Medford has at all times during the year had the hearty support of His Honor the mayor, while citizens, as a rule, have co-operated in a very gratifying way. We cannot dismiss the discussion of the conditions of this city without reference to the notable and most practical assistance given to the work by Medford's honored citizen and well-known philanthropist, Gen. S. C. Lawrence. Notwithstanding the enormous expense entailed in combating the moths upon his own property, General Lawrence has voluntarily assumed the care of many badly infested private estates, and has also assisted the city in destroying the moths on several of its most important streets. Further than this he has at his own expense during the fall months thinned and put in good condition the entire water board property above mentioned, so that a repetition of the moth outbreak shall not occur here in 1907. His constant and hearty co-operation in the battle against the moths is worthy of the highest commendation, not only of the citizens of Medford, but of all tree lovers in the moth-infested district.

MELROSE.

J. J. McCULLOUGH, *Local Superintendent.*

This city is comparable to Malden or Medford in its degree of infestation by the gypsy moth. Of particular note have been the complaints of damage by the moth pest in the Highlands district, adjacent to Wakefield. During the winter months the local superintendent carried on a very vigorous campaign against both species of the moths, and followed this up by bur-lapping and the use of sticky bands on the street trees. Notwithstanding these efforts, some damage was done by the moth pests in certain of the residential districts, while the woodland sections suffered most severely. The city of Melrose is unfortunate in that it comes close to the dividing line between towns which receive an 80 per cent. rebate and those to which a 50 per cent. rebate only applies. Because of the low valuation, it has been most difficult to raise sufficient funds to properly combat the moth pest at critical times. While the work in the




Remains of beautiful pines killed by the gypsy moth, Pine Banks Park, Malden, 1906.

residential sections has been highly effective, the only thing possible in the line of woodland work has been the spraying and burlapping of the infested borders and the main streets, and as a result gypsy moth colonies have increased in such sections.

In the Pine Banks Park, which is one of the most beautiful small parks lying to the north of Greater Boston, a strong campaign was made against the moths during the past season. This park lies within the borders of Malden and Melrose, and is controlled by a joint board of park commissioners representing both cities. Upward of 600 dead pines, killed by the gypsy moth, were removed; and during the caterpillar season a vigorous campaign of spraying was carried on, with the result of greatly lessening the numbers of the insects. Burlap bands were used with good effect during the caterpillar season, while spraying operations were equally successful. While this park is still badly infested, it is but fair to say that a notable improvement in conditions is apparent over those existing in 1905. If this park is to be preserved for the benefit of the two cities, in whose ownership it is held conjointly, a thorough and systematic campaign against the gypsy moth will be necessary. At the present time the park is regarded somewhat in the light of an onus upon both cities; yet the superintendent believes that future years will amply demonstrate the wisdom of thoroughly caring for this, one of the most beautiful pleasure spots in the entire metropolitan district. It is to be hoped that the gypsy moth problem here will be placed in the hands of some board or official representing both cities, so that necessary operations may be prosecuted in proper season, and with the proper financial support.

So far as the general proposition of caring for the infested district at Melrose is concerned, it may be said that the cost of keeping under observation the streets and residential districts will be less than in 1905. The operations in woodlands and partly improved property should be prosecuted with the utmost vigor. Burlaps will be generally required throughout the city, and a vigorous spraying campaign should show good results.



NAHANT.

THOMAS J. DEVENEX, *Local Superintendent.*

This town from topographical considerations is an ideal one to free from the gypsy moth. It is practically surrounded by water, being connected with the mainland only by a long strip of sandy beach. The local superintendent made a thorough inspection of all private property in the town early in 1906, destroying all gypsy and brown-tail moth nests found. Several of the large estates were found seriously infested by the gypsy moth. During the caterpillar season all trees in the town were burlapped and carefully attended, with the usual satisfactory results. The work done by the War Department on the United States reservation has been carried out in a very thorough manner, and the property practically freed from the gypsy moth. Evident improvement has been made in clearing the private estates, and if the efficient work done this year by the local superintendent can be continued, there should be no difficulty in clearing Nahant from the gypsy moth, aside from the scattering insects which will no doubt be brought in from year to year so long as other towns near by remain infested.

NEWTON.

CHARLES W. ROSS, *Local Superintendent.*

The work against the gypsy and brown-tail moths in this city has been carried on in a very satisfactory manner during the season, and has been well supported by the local authorities. It is to be regretted that more burlap was not used during the summer months, but we have assurances that another season will see a general burlapping campaign over the city. In the sections where the burlap was used and in those where it is possible to make a thorough cleaning of the trees in the winter months the conditions are greatly improved over those of 1905. In other sections of the city, particularly in the woodlands, there has been a large increase in the numbers of the gypsy moth, the colony on Parker Street being the most important infestation. The work of clearing the city trees of moth nests was begun early in November, and is being vigorously prosecuted.

Next season's work should include the liberal use of the burlap, and a large amount of spraying will also be necessary.

The gypsy moth has become well established in Newton, and much careful and thorough work will be necessary to hold it in check.

PEABODY.

JAMES F. CALLAHAN, *Local Superintendent.*

This town continues to be seriously infested by the gypsy moth, although a net gain has been made in clearing the street trees and private property. In the woodlands the moths have increased to alarming proportions, and these latter colonies should be isolated, or at least cut off from the highways, before the opening of another caterpillar season. The local superintendent has continued to give the town excellent service, finished his work of clearing private estates early in the season, and carried on the burlapping and spraying campaign so far as funds would permit, with good results.

In the section near Bartholomew's Pond, near the Lynn Woods, a very serious woodland colony exists, while the woodlands in West Peabody are dangerously infested. In the latter section upward of 12 acres were stripped bare by the insects last July. It has become necessary to thin a protective belt on each side of Lynnfield Street, to prevent the distribution of the moth next season. This work will be carried on also on Lowell and Forest streets, for the same reason.

At the present time the work of clearing street trees and thinning protective belts is in progress.

QUINCY.

T. F. BURKE, *Commissioner of Public Works.*

From the immense amount of travel passing through Quincy to South Shore points, it is of greatest importance to keep this city relatively free from the gypsy moth. Inspections having shown the insect generally scattered over the town, after the completion of the winter work the trees were generally burlapped, and during the summer received good attention. There was not sufficient work, however, done on private estates to prevent the increase of the moth there, and as a result there

was some stripping of trees in a few localities. It became possible in the fall months to start a more vigorous campaign against the moth, and to do a considerable amount of scouting through the local forces. At the present time the work of cleaning street trees is in progress. The portion of the city known as Hough's Neck has been quite thoroughly cleaned, with the exception of two orchards, and found in better condition than last year. In the work against the brown-tail moth early in the year a force of some 30 men was employed, and as a result there was but little injury by this insect, except where scattered webs were left on the ground.

It has been difficult at times to secure proper support for the work at Quincy, but there is now in evidence a more general desire to comply with the requirements of the law and to co-operate with the efforts being made by the central office.

READING.

GUY A. HUBBARD, *Local Superintendent.*

This town is another example of the advantage of having a thoroughly well-trained man in charge of the local operations. The local superintendent, because of his information acquired in the former moth work under the direction of the Massachusetts Board of Agriculture, was able to bring to the work of clearing Reading from the moth pests the advantage of experience acquired in practical field operations. His efforts have been at all times ably supported by the officials of the town, while the co-operation of interested citizens has been equally constant and effective.

Throughout the town the street trees are in a notably improved condition as regards both moth pests, while the same is equally true of the thickly settled residential district. The superintendent regrets to note, however, the gradual extension of the woodland colonies in the westerly and northerly sections of the town, where, because of the lack of suitable funds, the gypsy moth has been allowed to multiply in unrestricted numbers. It is to be hoped that another season sufficient funds will be available for the thorough prosecution of the work against the moths in these sections.

Next season's work will include the general use of the burlap, while spraying will be necessary in certain infested districts. The great number of car lines converging at Reading Square make it most important that the trees in this section should be thoroughly cared for.

REVERE.

A. H. DAVENPORT, *Local Superintendent.*

Although the work in Revere has not shown the progress that it should have, in view of the amount of money expended, at the same time there has been much improvement over the conditions of last year. There has been a quite general enforcement of the law on the infested private estates, while the street trees have been well cared for. It is to be regretted that more in the way of cutting wild cherry trees and worthless infested brush along the many farm walls in this town could not have been done. In the northern part of the town, notably at Oak Island, infested trees have been badly neglected, with the result that a great deal of spreading of the moths has no doubt occurred from this point. It is hoped that the arrangements now in progress will result in clearing this district from the moth pests. Next season's work should include a thorough effort to burlap all the street trees of the district, clearing of the Oak Island section of brush, the spraying of the remaining trees there and also those in the important infested residential sections.

SALEM.

AMOS STILLMAN, *Local Superintendent.*

In the report for 1905 the superintendent stated: "The problem of suppressing the moths in Salem is a most serious one, and constant effort and the expenditure of a large amount of money for some years to come will be necessary to keep them under control."

The results developed in this city last season amply verify this statement and prediction. During the months of February, March and April the work of clearing the badly infested street trees was prosecuted in a generally satisfactory manner, but most unfortunately practically no funds could be obtained to

clear the numerous badly infested private estates. In spite of repeated requests and protests by this office, this work was neglected, while during the month of May, when spraying operations should have been prosecuted, no funds were obtainable for this most important work. In fact, throughout the entire season the efforts of this office to obtain funds wherewith to carry on a systematic campaign against the moths over the entire city have been most seriously delayed and hampered by the non-action of the city government, — a condition of affairs wholly unexpected in a city which has shown in so many ways a constant and most commendable public spirit. No city or town in the entire infested district has caused the superintendent so much anxiety during the past year as Salem, and in none has so little progress toward controlling the moth been made.

As a result of the neglect to clear the moths from private estates, these were soon seriously injured by the caterpillars, which then swarmed in large numbers into the street trees; and, as a consequence, the general condition of the whole city is much worse than in 1905. While the general use of burlap on street trees and the spraying of certain badly infested sections gave good results in many cases, it was impossible to overcome the effect of the neglected private estates. During August, September, October and November, when, had funds been available, a large amount of work could have been done with reference to making a net gain next year, it was practically impossible to obtain the necessary appropriations.

If the people of Salem wish to have the moth increase in their city to a point where they will be obliged to decide between very large expenditures or the loss of their trees, the dilatory policy of 1906 should be continued. If, on the other hand, the moth is to be brought under control in this city, sufficient funds should be provided for the thorough cleaning of the street trees and the vigorous enforcement of the law on private estates before the next caterpillar season. Following this work it will be necessary to burlap practically all the trees in the city, and to spray a very large percentage of them.

Work on the street trees was begun December 3, and is now in progress.

SAUGUS.

THOMAS E. BERRETT, *Local Superintendent.*

Work in this town has continued vigorously throughout the year, it being perhaps as badly infested by the gypsy moth as any town in the district. During the winter months the work of clearing private estates was prosecuted vigorously, with the result that by the opening of spring nearly every estate in the thickly settled district had been treated. A considerable amount of cutting brush and thinning trees was also required in this section. Trees on private estates were treated with Tanglefoot, and during the early caterpillar season hundreds of thousands of insects were crushed beneath these bands. The street trees and also several large areas of woodland near residential sections were burlapped and attended throughout the season. As soon as the caterpillars had appeared in numbers, spraying with two large power outfits was carried on in the residential section and along the principal infested streets, this work giving most excellent results.

In the Breakheart Forest reservation, where the owners had made large expenditures to protect their trees, the town co-operated to a considerable extent in destroying egg clusters, burning over ground, and burlapping. The results here were satisfactory, taking into consideration the amount of money expended. The fall inspection shows a marked improvement in the general condition of street trees and in the thickly settled districts. In the woodland, necessarily neglected during the past season for lack of funds, the moths have made material gains. These woodlands are principally of low valuation, and unless larger appropriations are available, or unless the owners are willing to co-operate liberally with the town and State in combating the moth, these sections must necessarily suffer severely in future years. An effort will be made, by thinning protective belts, to isolate some of the more important of these colonies, and at least prevent them from extending to the highway.

The F. P. Bennett estate on Forest Street, with one or two other adjoining properties, for some years seriously infested, has now been put in good condition for next season's work.

If the good work done in Saugus to date can be followed up by a vigorous campaign of burlapping and spraying next season, much progress will be made in the sections so treated. Liberal plantings of imported parasites have been made in Saugus, and it is hoped that in the course of a few years these beneficial insects will make themselves felt here. The work in this town has received hearty co-operation on the part of town officials and citizens alike, has been well handled, and the results accomplished are of superior quality.

SOMERVILLE.

CHARLES I. BUCKNAM, *Local Superintendent.*

We are glad to be able to report again the excellent condition of this city with reference to the moths, and to comment most favorably upon the quality of the work done here. The condition of the trees in this city is a striking illustration of the wisdom of employing a trained and efficient man to care for the moth pests, and keeping him continuously on the work, without reference to local political changes.

Somerville is peculiarly exposed to continued infestation by the gypsy moth, owing to its proximity to badly infested sections of Medford, Arlington and Cambridge; yet, by reason of the thorough work done here each year, no more gypsy moth colonies have become established. It will be well to make a general use of the burlap throughout the city next season, while spraying will probably be necessary in a few localities.

STONEHAM.

G. M. JEFTS, *Local Superintendent.*

We are again glad to commend the efficient and effective work done against the gypsy and brown-tail moths in this town by the local superintendent. Along the line of the cars from Winchester to Reading, where two years ago thousands of gypsy moth egg clusters could be seen, but a few are now discernible. Over the entire town the street trees are in excellent condition, and there has been a vigorous and general enforcement of the law on private estates. The use of sticky bands and burlap during the caterpillar season has proved most effective in this town. An

effort has been made to thin the trees and cut the underbrush along the border of the Fells reservation of the metropolitan parks system, and this is still in progress. Over some 25 acres north of Doleful Pond the brush has been cut, dead and decayed trees removed, and the remainder put in good condition for next season's work. Operations are now in progress on the Dyke estate, bordering the reservation, and it is hoped that by the opening of the caterpillar season the park border in Stoneham will be well protected from caterpillar invasion from without.

Within the residential section an evident gain has been made against the moths, and it is apparent, if the present good work can be properly followed up, a satisfactory permanent gain will be secured.

SWAMPSCOTT.

GEORGE NEWHALL, *Local Superintendent.*

The winter work by the local superintendent showed nearly every estate infested by the gypsy moth, often in large numbers. In the pasture area adjoining Salem, which was cut over the previous fall, the brush and débris were burned in May, while the caterpillars were small, with very satisfactory results. The remaining trees in this section were burlapped and attended during the summer. The fall inspection shows a great improvement in the condition of the street trees throughout the town and in the residential districts not adjoining woodlands. Where such districts adjoin infested woodlands there has been an increase in the numbers of the moth, — a fact which emphasizes the importance of brush cutting and thinning operations, which the local superintendent has so vigorously prosecuted the past fall.

If the work done here can be followed up by thorough spraying and burlapping next summer, still more gain will be made in bringing the moth under control.

WAKEFIELD.

W. W. WHITTREDGE, *Local Superintendent.*

The condition of affairs as regards the gypsy moth at Wakefield is most serious, though important gain has been made in the combat against the brown-tail moth. Gain has been made in

clearing the street trees in residential sections, but the gypsy moth woodland problem is distinctly worse than heretofore. During the early part of the year there was a quite general enforcement of the provisions of the law as applied to private estates. The use of the burlap on street trees gave generally satisfactory results, while spraying operations were notably effective. It is apparent to one familiar with the conditions of this town that a large amount of burlapping and spraying must be done here in 1907, if a gain is to be made against the moth pests.

The work against the moths has been well supported by the local town officials, and has been well administered. Particularly commendable is the effort made by the local authorities to thin the trees along the border of the very badly infested section at Greenwood, which adjoins the western division of the Boston & Maine Railroad.

WALTHAM.

RICHARD A. JONES, *Superintendent of Streets.*

During the early part of the year the residential section of the city was cleared of both gypsy and brown-tail moth nests, and work was also prosecuted at Prospect Hill park and in the large woodland colony in the easterly part of the city. In the latter infested district upwards of 20 acres of woodland and pasture were cut over and burned, in co-operation with the efforts of the owner, and the condition here at the present writing is much improved over that of 1905. A great deal of work was also done along infested roadsides in the eastern part of the city.

There was not a sufficient amount of burlapping done in Waltham during the summer, but the burlaps used on Waltham Common and a few other particularly badly infested places in the city were sufficient to demonstrate the occurrence of the gypsy moth in considerable numbers. There was also a limited amount of spraying done in the most badly infested spots, with good results. While the insects were in the pupal stage a general inspection of the entire residential section was made, and thousands of pupae destroyed by means of wire brushes, thus materially reducing the numbers of nests that would other-

wise have been found in the fall inspection. At the present writing the trees in the worst-infested sections of the residential district have been cleared of the gypsy moth nests up to the snow line, and about two-thirds of the street trees cleared of both gypsy and brown-tail moths. A great deal of cutting of brush along infested roadsides has been carried out under the direction of the local superintendent.

Waltham presents one of the serious problems of the infested district, as where the gypsy moth has been neglected it has increased remarkably in the past two years. The woodlands are generally infested, and some of the colonies have reached dangerous proportions. The city has a costly moth problem before it, and much careful and thorough work must be carried on in 1907, if a gain is to be made against the insects. In the work at Waltham we have had the continued assistance and co-operation of the local authorities, and, if suitable funds can be provided for the 1907 operations, a good showing will be made by the close of the year.

WATERTOWN.

JOHN C. FORD, *Local Superintendent.*

The principal work in this town has consisted of cutting brush and the general clearing up of infested roadsides on the principal streets, burlapping and spraying trees in Whitney Hill Park, the removal of worthless trees, and the cementing of cavities in those which have become decayed. The street trees show an improved condition over 1905; but little gain against the gypsy moth has been made on private estates, owing to ineffective local work or work done by irresponsible contractors.

At the Watertown arsenal grounds, which have been badly infested, a remarkable improvement has been made, largely owing to the personal interest and efforts of the commandant. At the present writing the work of clearing the street trees is in progress, and should be nearly completed by January 15. The work next season should include the general use of the burlap over the town, and the spraying of trees in the most badly infested sections.

WINCHESTER.

IRVING T. GUILD, *Local Superintendent.*

The combination of an efficient local superintendent and liberal financial support, and the hearty co-operation of nearly all the citizens of this town, has yielded most satisfactory results during 1906. A vigorous enforcement of the provisions of the law was made on private estates early in the year. Following this, street trees were sprayed and those on a few main streets burlapped. A more general use of the burlap would doubtless have saved considerable expense in the fall cleaning work. The roadsides throughout the town have been cleared of brush, and in many important gypsy moth colonies adjoining streets a protective belt 50 feet wide has been cut, and will have thorough attention next season.

At the present writing the street trees have been cleared of moths, together with the important infested area of Wildwood Cemetery. Nearly all the woodland on the easterly side of the town adjoining the Fells reservation has been thinned out and put in excellent condition for exterminative work. The woodland section on the westerly side of Winchester still remains badly infested, and will require large expenditures before the gypsy moth is brought under control here.

The Myopia Hill district, containing a number of magnificent private estates, still remains badly infested, and should receive vigorous treatment before the eggs hatch in 1907. In the latter section a general clearing of brush and decayed trees is advised, and, if this can be followed by a vigorous burlapping and spraying campaign, the gypsy moth should be brought under control by the end of the caterpillar season.

WINTHROP.

FRANK W. TUCKER, *Local Superintendent.*

Marked gain has been made in this town in the battle against the gypsy and brown-tail moths. The work here has been ably conducted, and has at all times received the hearty co-operation of the town officials and interested citizens. From its topographical location Winthrop is comparable to Nahant, it being connected with the mainland by a narrow isthmus. From this

condition there will be no serious difficulty in clearing Winthrop from the gypsy moth, aside from the possible danger of continued reinfestation by means of traffic from the badly infested districts of Revere and Malden. In attempting to carry out the provisions of the law on private estates, early in the year, many citizens brushed or scraped the egg clusters of the gypsy moth to the ground, with the belief that the ordinary winter weather would destroy the vitality of the same. The fallacy of this belief was well demonstrated during the summer months, when trees burlapped in such districts showed from 10 to 300 caterpillars apiece at each turning during the height of the caterpillar season. It is also regrettable that at Winthrop a limited amount of creosote deficient in egg-killing properties was used. These criticisms are of a minor nature, and the town as a whole is in a greatly improved condition, as compared with that of 1905.

WOBURN.

JAMES MOLOY, *Local Superintendent.*

In last year's report it seemed necessary to criticise severely both the quality of work and the lack of work done in this city. During the last season the necessary operations against the moths, while often handicapped at critical stages from lack of funds, have been carried on effectively and have been well administered. At all times the interests of this work have had the hearty support of His Honor the mayor, and the instructions given by this office have been promptly carried out. The lack of efficient work in the early months of the year was particularly emphasized by the condition of the badly infested sections during June and July. Some spraying was done, with good results, but this work only covered a small section of the badly infested district. We have been greatly assisted in this town by the work performed by Mr. D. M. Rogers, acting under the direction of Dr. L. O. Howard of the United States Department of Agriculture.

While the city still remains badly infested with the gypsy moth, we feel that a net gain has been made in the residential sections, and that, if the present efficient work can be thoroughly carried out and receive proper financial support, a much better showing will be made in 1907.

Outer Towns.

ABINGTON.

C. FRED SHAW, Local Superintendent.

At the close of the inspection made last winter some 20 estates had been found infested with the gypsy moth. During the caterpillar season the trees in these localities were burlapped and fairly well attended, although it would have been desirable to burlap the trees over a much larger area, in order to arrest any extension of the colonies. There are many old orchards in this town containing trees with hollow trunks and branches, which offer ideal hiding places for the moths. An examination of these orchards shows about 50 infested localities, and it seems probable that more will be discovered when it becomes possible to scout thoroughly the entire town.

The usual campaign of cutting worthless trees and the general use of burlap will be required here next season.

ACTON.

CHARLES J. WILLIAMS, Local Superintendent.

The work in this town has progressed satisfactorily during the past year, under the efficient direction of the local superintendent. The work against the brown-tail moth, which was completed in April, showed that the insect occurred in scattering numbers over the entire town.

The four gypsy moth colonies were cleared of underbrush and cavities cemented, this work being followed up by burlapping and spraying. Much progress was made in suppressing these colonies.

In November the local superintendent commenced the work of scouting the orchards of the town, and found over 200 of them infested by the gypsy moth. This discouraging result indicates a general infestation of the entire town, and will make necessary much careful work during 1907, when the hollow and worthless trees should be cut and burned. Following this, much cementing and tinning of cavities will be necessary, together with the general use of the burlap in the caterpillar season, while spraying will be required in many of the infested orchards.

ANDOVER.

J. H. PLAYDON, *Local Superintendent.*

The general infestation of this town continues; in fact, the operations which we have been able to carry on here last fall show it to be much more seriously infested than had been expected. The gypsy moth has been found on many of the street trees throughout the residential section, while scattering infestations have developed in the woodlands, the southern part of the town offering the most serious problem.

Work against the brown-tail and gypsy moths on private estates was completed in a very thorough manner by the local superintendent early in the year. Trees infested by the gypsy moth were burlapped and attended during the summer, with satisfactory results. During the fall months a systematic scout of the town was begun.

At this writing about three-fourths of the town have been covered, the brush has been cut and burned along infested roadsides, and a beginning has been made in cleaning the infested orchards and putting them in proper condition for next season's work. In this town there are far too many neglected orchards of hollow apple trees, generally infested by the gypsy moth. These hollow trees should be either cut and burned, or else properly cemented so as to destroy the hiding places of the insect.

It is desirable that the town purchase a power sprayer for use in its work next year, particularly in connection with the infested orchards.

AMESBURY.

A. L. STOVER, *Local Superintendent.*

Work on private estates started promptly January 1, the entire town being thoroughly covered in a search for both gypsy and brown-tail moths. Many of the property owners gladly met the entire expense of clearing their estates, while in the case of the majority of the remaining estates the liability under the law met the cost of the work. While the winter work was in progress, diligent search was made for the gypsy moth, but no new colonies were located.

During the summer the gypsy moth colonies were burlapped,

and the burlaps thoroughly attended during the caterpillar season, the important development being the finding of a large number of caterpillars in the section near the Chain bridge. Last fall it was possible to make a thorough scout of the residential section, with the result that 49 new colonies of the gypsy moth were located, none of them of alarming size. A limited amount of cutting of brush on all infested roadsides and in the vicinity of the colony at the Chain bridge was done last fall. About two-thirds of the street trees have been cleared of the moth, this work being in progress at this writing.

Notwithstanding the finding of additional gypsy moth colonies, the condition of Amesbury is notably better than in 1905, since we now have a fairly exact knowledge of the condition of the entire town, while the brown-tail moth has practically been eliminated from the situation.

ASHLAND.

FRANK A. MORSE, *Local Superintendent.*

During the month of April the work against the brown-tail moth was completed in this town, and the known gypsy moth colonies inspected and put in condition for summer work. During the summer all trees were burlapped and carefully attended during the caterpillar season; and, as a result of the general use of burlap on street trees in infested districts, an increased infestation in the center of the town was located.

An inspection along the electric car line from Framingham to Ashland developed two infested estates. During the late fall months an inspection of the town was made, and several new gypsy moth colonies discovered. These are now being put in proper condition for next season's work.

AVON.

V. L. SNELL, *Local Superintendent.*

But little work has been done in this town except by inspectors employed by this office. The trees in the vicinity of the two gypsy moth colonies located in 1905 were burlapped, but were not thoroughly attended during the caterpillar season. As a result, but little gain has been made in these colonies, and the

fall inspection shows 3 additional infestations, one of them being at a place to which the wood cut in one of the old colonies had been carried.

Clean and thorough work will be necessary here to wipe out these small infestations next season.

AYER.

L. A. CARMEN, *Tree Warden.*

A single gypsy moth colony was found near the center of the town in September, by an inspector from the central office. As yet it has not been possible to complete a thorough inspection of the town, but this will be taken up at the earliest possible moment. Since Ayer is an important junction point for several lines of railroad, it is peculiarly liable to infestation, and for the same reason it is most important that no large colonies be allowed to develop.

BARNSTABLE.

HENRY W. BODFISH, *Local Superintendent.*

The single gypsy moth colony found in 1905 has had careful attention during the season, all trees in the vicinity being burlapped and well attended. No further findings of the moth have been made at Barnstable, but it will be desirable to have the roadsides and orchards thoroughly scouted this winter.

BEDFORD.

W. A. CUTLER, *Local Superintendent.*

The work during the year has been carried on under several different local superintendents, and at times there have been unfortunate delays, due to the difficulty in obtaining suitable labor. The town is generally infested over its entire area by the gypsy moth, the most important colonies being along the Burlington and Lincoln roads.

In the center of the town and at Lexington Park, to both of which places there is much travel during the summer months, a very general infestation by the moth exists.

The usual campaign of burlapping was carried on in a satisfactory manner during the summer, and after the caterpillar

season a large amount of infested brush along roadsides was cut and burned.

We regret to record a notable increase of the gypsy moth in the woodlands of this town, which will necessitate vigorous work in the future if the pest is to be controlled there. Next season's work should include the cutting or cementing of large numbers of infested apple trees, the use of burlap in all infested districts, while it will also be desirable to purchase a power sprayer to supplement the above operations.

The town officials have given this office all possible assistance, but greater interest on the part of citizens in co-operative work will be necessary, if marked progress is to be made in controlling the moth.

BILLERICA.

FRANCIS J. DOLAN, *Local Superintendent.*

The moth work in the early part of the season did not show entirely satisfactory results, but during the following months was carried on in a generally effective manner.

Burlaps were used in the gypsy moth infestations and along the main streets with good results, and a limited amount of spraying was done. In the fall months the infested roadsides were cleared of brush and undesirable trees, and a limited amount of scouting accomplished.

The most generally infested section is in the woodlands on the south side of Nuttings Pond. Next season's work should include the cutting of decayed and hollow trees and the use of burlap, if funds are available. It will be desirable to purchase and use a power sprayer.

BOXBOROUGH.

JAMES S. BRAMAN, *Local Superintendent.*

The preliminary scouting of this town by Inspector C. E. Merrill revealed the presence of several gypsy moth nests. Late in November it became possible to send a scouting gang from this office to make a general inspection of all roadsides and orchards, with the result that over 30 infested estates have been located in various parts of the town. All these moth colonies are as yet in the incipient stage, but will require care-

ful attention during 1907, when the worthless and hollow trees should be cut and cavities cemented, to be followed by a general use of burlap wherever the gypsy moth has been located. It seems probable that the woodlands may be more or less infested, and these should be scouted as soon as funds permit.

BOURNE.

HIRAM F. BAKER, *Local Superintendent.*

The trees in the locality infested by the gypsy moth were burlapped and carefully attended during the summer, but it would have been desirable to use the burlap over a much greater area. The fall inspection shows an extension of the original colony.

BOXFORD.

CHARLES PERLEY, *Local Superintendent.*

In January the private estates and the rest of the residential section of the town were thoroughly covered by the local authorities, and several gypsy moth colonies were found. A large proportion of the owners cleared their trees of the moths, the remainder of the necessary work being done by the town authorities.

During the summer the gypsy moth colonies were thoroughly burlapped and attended. Inspectors from this office have found several small gypsy moth colonies along the roadsides and in the woodlands. It will be desirable to have the town thoroughly scouted at an early date, and until this is done no exact knowledge of the condition of the woodlands can be obtained. The work on the street trees is now in progress.

BRAINTREE.

E. E. ABERCROMBIE, *Local Superintendent.*

During the early part of the year the infested sections were thoroughly worked over, and following this burlaps were used with the usual good results. At the close of the caterpillar season the local force began the work of clearing infested orchards and cutting brush and superfluous trees along the roadsides. The local situation is very much complicated by the

presence of a number of orchards badly infested with the gypsy moth, with their usual complement of hollow, uncared-for trees. While the infested localities show a great improvement over 1905, there still remains a great deal in the way of scouting to be done. The local work has been well handled, and it has had proper financial support.

BRIDGEWATER.

R. J. MCNEELAND, *Local Superintendent.*

The infested sections were thoroughly cleaned during the early part of the year, the trees burlapped and well attended during the summer months. It has been possible this fall to do some scouting in the town, with the result that a few additional gypsy moth colonies have been located. These have been put in good order for next season's work, which will include the general use of burlap.

BROCKTON.

EDWARD MOTTAU, *Local Superintendent.*

Upward of 500 burlaps were applied to trees in the sections where the gypsy moth had been found in 1905. The principal infestations are at 439 and 832 Centre Street. Following the close of the caterpillar season, the city was thoroughly scouted by the local superintendent with the aid of an inspector from this office, and 7 new infestations were discovered. It is apparent that this city must be kept under close observation for some years, if the moth is to be brought under control.

CANTON.

AUGUSTUS HEMENWAY, *Local Superintendent.*

The woodland colony located in Canton early in the year was thinned and the underbrush burned. During the caterpillar season the trees in this section were thoroughly burlapped and attended, and a number of caterpillars destroyed. In the other gypsy moth colonies the burlap was used with good results, and the town as a whole is in a greatly improved condition as compared with 1905.

It will be desirable to have all the woodland thoroughly scouted in the near future.

CARLISLE.

G. G. WILKINS, *Local Superintendent.*

The gypsy moth infestations found in this town in 1905 were thoroughly treated during the summer months. In the fall the scouting gang employed by the State office made an inspection of the town, finding it to be generally infested, the colonies occurring principally in the old neglected orchards.

The local force has cut the brush along infested roadsides, and treated all infestations to date. The force is now at work cutting worthless orchard trees and cementing and tinning cavities in the remaining infested trees.

The orchard problem in this town is the most serious one, and it will require a great deal of careful work to control the moth here. The various camps along the Concord River are also danger points, which should be kept under constant supervision.

The local work has been efficiently managed, and a hearty spirit of co-operation shown by the town officials.

The work next year should include, aside from the customary operations, a great deal of spraying in the infested orchards; and to this end, if possible, a power sprayer should be used.

CARVER.

E. H. MURDOCK, *Local Superintendent.*

The sections where the gypsy moth was found in Carver during 1905 have had careful attention the past year. The trees in these districts were burlapped and attended during the summer, but no caterpillars were found.

It will be desirable to have this town thoroughly scouted in the near future, as it seems probable that the gypsy moth may occur in various places in the woodlands.

CHELMSFORD.

GEORGE B. B. WRIGHT, *Local Superintendent.*

The finding of a single egg cluster in this town in 1905 was regarded as an indication of the probable occurrence of the gypsy moth in considerable numbers. During the fall months it was

possible to make a thorough scouting of the town by the State forces, with the result that 25 caterpillars, 430 pupæ and 876 egg clusters were found scattered throughout the town, which should now be regarded as generally, although lightly, infested. As soon as the scouting had been completed, the local superintendent commenced a vigorous campaign of cutting and burning brush along infested roadsides, to stop the further scattering of the moth.

While some work has been done in the infested orchards, as in Carlisle and other towns in this vicinity, there are a very large number of neglected apple orchards, whose hollow trees afford excellent hiding places for the moths. The work here has been well supported by the local authorities, and well administered.

During 1907 large numbers of worthless apple trees should be cut and burned, and the usual methods of cementing and tinning cavities in the remaining trees, together with burlapping and spraying, should materially reduce the numbers of the moths. If possible, there should be a very general spraying campaign in the orchard districts of the town.

COHASSET.

JOHN S. CLARK, *Local Superintendent.*

The gypsy moth colonies in this town were looked after last summer in very good manner. The burlap was used in all of those in the residential districts. No important colonies have been discovered, although the gypsy moth is scattered over a large part of the town. In January, Inspector C. E. Merrill made an examination of woodland belonging to Messrs. Whitney and Mandell, and here gypsy moth egg clusters were found scattered in small numbers in all parts of the woods. These infestations were not cared for during the summer, and there has been a slight increase in the number of nests.

There has been a notable decrease in the brown-tail moth in this town.

CONCORD.

H. P. RICHARDSON, *Local Superintendent.*

As might have been expected in a town with such a reputation for prompt action in all matters affecting the public welfare, the work at Concord has received good financial support, has been well carried out, and at all times has had hearty co-operation on the part of citizens. The work against the brown-tail moth, completed early in the year, was followed by the burlapping of all trees in the vicinity of known gypsy moth infestation, upward of 5,000 trees being thus treated and attended. Following the caterpillar season the orchards throughout the town have been inspected and put in proper condition for exterminative work by trimming, cementing cavities, etc.

A general orchard scouting made in the fall months showed the gypsy moth to be present in notable numbers in all sections, and the woodlands in the northern part of the town were also found generally infested. This result, together with the known infestation of the woodland around Fairhaven Bay, leads us to suspect the same general occurrence of the moth in the southwestern part of the town. It is proposed to continue this work of scouting, through the local organization, until an adequate idea of the conditions of the whole town has been obtained. At the present time the work of clearing town trees of the moth is in progress. Aside from the scouting operations mentioned, the plan of work for 1907 contemplates necessary cutting of hollow and worthless trees in orchards, cementing cavities, the general use of the burlap and spraying operations wherever the moth is abundant.

DEDHAM.

GEORGE W. PHILLIPS, *Local Superintendent.*

There was considerable delay in this town in notifying property owners to clear their estates, and the law pertaining to neglected estates was not as thoroughly enforced as is desirable. To assist the local authorities, inspectors detailed from this

office scouted a considerable part of the town, while Inspector Merrill made a quite thorough examination of the woodlands, and found several gypsy moth colonies near the Westwood line from the east side of High Street to the Charles River. These woodlands, principally held by wealthy citizens, received proper attention during the summer, in connection with the efforts made by the local superintendent, and general use of the burlap here gave good results.

The inspection of the town now in progress has shown much improvement where the burlap was used, although a few small additional colonies have been discovered.

The brown-tail moth is less abundant in Dedham than in 1905.

DOVER.

G. D. HALL, *Local Superintendent.*

It has been impossible up to the time of this writing to make a thorough inspection of the town. All gypsy moth infestations located by our inspectors have been treated in a most thorough and efficient manner by the local superintendent, while citizens have shown a most commendable desire to co-operate in the work. The colonies found to date have been put in good condition for next year's campaign, and it is hoped before the opening of the caterpillar season to make at least a roadside and orchard scouting of the entire town. In the woodland colonies underbrush and worthless trees have been removed, and thinning operations have been carried on preliminary to the burlapping. During the season of 1906, 2,318 trees were burlapped and 1,826 caterpillars taken.

DRACUT.

ROCKWOOD D. COBURN, *Local Superintendent.*

An examination of this town was made by employees of the central office during September, 1906, and a total of 228 gypsy moth egg clusters and 40 pupæ were found and destroyed. In common with other towns of this district, the principal infestations were found in orchards, and are widely scattered over the entire town. The local work has been organized, and is in progress at the present writing.

The problem here is similar to that at Carlisle and Chelmsford, and much careful work will be required in the orchards during the coming summer.

DUXBURY.

H. A. FISH, *Local Superintendent.*

The 31 infestations of the gypsy moth in Duxbury located in 1905 received careful attention during the summer. Burlap was generally used, and spraying was also done in the worst-infested sections. The local superintendent has practically completed an inspection of the residential district and some of the more important woodlands, and destroyed nearly 700 egg clusters. On a few estates a limited amount of cutting and burning of brush and worthless trees will be required to put the colonies in condition for next season's work. At one point in the woodland, in the rear of the cemetery, used as a public dump, a small colony has been located which will be cleared up before the caterpillar season.

EAST BRIDGEWATER.

WILLIAM T. GREENE, *Local Superintendent.*

The trees in the infested district were burlapped and well attended, with good results. Owing to the known existence of the gypsy moth in this town for some years, it seemed advisable to detail an inspector to make a thorough examination of the streets and orchards, which was done following the close of the caterpillar season. In this work Inspector Hodgkins was assisted by employees of the local force, and as a result upward of 60 infested places were located, a few of them being of sufficient size to cause anxiety. These infestations will be put in good order before the caterpillar season of 1907.

The work against the gypsy moth here has been most efficiently directed, and has had good local support.

EASTON.

R. W. MELENDY, *Local Superintendent.*

It became possible to make a scout of the principal roads of this town during the fall season by an inspector detailed from this office, and as a result 3 small gypsy moth colonies were lo-

ated. The local superintendent is now making an inspection of the whole town, but at last reports had found no additional infestations. We have assurances that the moth colonies located will be put in proper condition for next season's work, and will receive thorough attention during the year.

FRAMINGHAM.

N. I. BOWDITCH, *Local Superintendent.*

Again we are able to report work of excellent quality done against the moths in this town, and the most gratifying support of the field operations on the part of town officials and citizens alike. During March and April general scouting operations were carried on by the local force, and as a result a general gypsy moth infestation of the entire town was discovered, although none of the colonies are of serious proportions. No general inspection has as yet been possible of the woodlands, but we have reason to believe that they are slightly infested.

During the summer the trees in all the infested districts were burlapped and thoroughly attended. Spraying operations in the important colonies on the street trees in the residential section gave excellent results. The most seriously infested section appears to be in the Saxonville district, where nearly 20,000 caterpillars were taken, although South Framingham and Framingham Center are also generally infested.

During the fall months a great deal of excellent work has been done in the infested orchards, in the way of cutting worthless trees and tinning or cementing cavities to destroy the hiding places of the moth. The general use of the burlap throughout the town, both on public and private trees, is recommended for 1907, together with spraying operations in all the important colonies.

GEORGETOWN.

WILLIAM BRAY, *Local Superintendent.*

The local superintendent finished destroying brown-tail moth webs on private property in January, in a very satisfactory manner. Inspector Saul Phillips having found several small colonies of the gypsy moth, it became necessary to use the burlap to some extent during the caterpillar season.

A fall examination by Inspectors Phillips, Samson and Sallee showed 75 new gypsy moth colonies, one on Andover Street containing over 200 nests. We have endeavored to give this town all the assistance possible in the way of inspection, but a large part of the territory remains to be covered.

It seems probable that the gypsy moth occurs in scattering numbers over the entire town, and if such proves to be the case, double expenditures will be required here next season.

GROTON.

CHARLES WOOLLEY, *Local Superintendent.*

During September the entire town except the woods was scouted by employees of the central office, with the result that the gypsy moth was found scattered in small numbers, the principal occurrences being in the center. All told, 7 estates were found infested. All egg clusters located were treated, and local work against the moths will be organized in the near future.

From the great amount of summer travel to the Groton School, this town will require careful inspection each year. Groton is one of the most beautiful of our country towns, and it is important that no effort should be spared to stamp out the gypsy moth infestations known to exist here.

GROVELAND.

FRED A. WOOD, *Local Superintendent.*

Early in the year brown-tail moth webs on private estates were destroyed, while the local superintendent did a limited amount of scouting for the gypsy moth.

Inspector Phillips has found several new infestations during the season, those found early in the year being burlapped and attended. The locality causing most anxiety to this office is that known as the "Pines," and owned by the Boston & Northern Street Railway Company. Because of the numbers of people visiting this park during the summer months, it is most important that it should be kept free from the gypsy moth; and the superintendent wishes to acknowledge the co-operation received from the railway company in accomplishing this end.

The local superintendent has cut the brush along the badly infested roadsides, and at the present time has a force engaged in clearing the street trees of the moth. This town should also be thoroughly scouted as soon as funds are available, since it is probable that colonies to a greater or less extent exist in the woodlands.

HALIFAX.

FRANK D. LYON, *Local Superintendent.*

The use of burlap in the known gypsy moth colonies during the summer gave excellent results. Fall scouting operations showed several additional colonies, the principal one being on Oak Street near the Pembroke line, where the owner of the property carries on a local express business. This place should have very careful attention. The neglected apple orchards in this town are of course a constant source of danger, and should be well looked after during the summer months.

HAMILTON.

GEORGE H. GIBNEY, *Local Superintendent.*

The local superintendent made a vigorous campaign against the moths on private property early in the year, being greatly assisted in his work by the property owners. Many citizens cleared their own estates, while other property owners employed contractors, with good results.

The usual campaign of spraying and burlapping was carried on in a satisfactory manner, and with good results during the caterpillar season. The popular resort known as "Asbury Park" is thoroughly infested by the gypsy moth, and, while the trees there were burlapped and attended diligently during the season, it will need constant attention for several years.

It seems probable that the entire woodland is more or less infested, and should be thoroughly scouted in the near future.

The excellent public spirit shown by the officials and citizens of this town is worthy of the highest commendation.

HANOVER.

W. S. STODDARD, *Local Superintendent.*

The scouting work done by the local superintendent in this town developed upward of 120 estates infested by the gypsy moth. The trees in the infested district were burlapped, as well as those along the principal streets, and a limited amount of work was done in trimming trees, cementing cavities, etc. The known infestations are now in much better condition than heretofore, but further scouting operations are desirable.

HARVARD.

GEORGE C. MAYNARD, *Local Superintendent.*

Early in December an inspector from this office while working in Boxborough located a single gypsy moth nest over the line in Harvard. The work of making a thorough examination of this town has just commenced.

HANSON.

A. L. DAME, *Local Superintendent.*

The local work here has been well carried on, the trees on the 50 or more estates infested by the gypsy moth were burlapped and attended, and a net gain has been made in reducing the numbers of the moths. The work in this town is seriously handicapped by the large numbers of neglected orchards, and, unless a general campaign of cutting worthless trees, cementing cavities, etc., can be carried on, it will be impossible to do much more than hold the gypsy moth in check.

At the fall inspection nearly 800 egg clusters were found, and at the present writing the work of clearing private estates is in progress.

The ponds in this town are a favorite resort for summer cottagers, hence there is great danger that the moth will be brought into such localities from outside infested districts, and, further, that any colony established around the shores of the pond may soon become a source from which the insects may spread.

The moth colony at Oldham Pond should receive particular attention during 1907.

HAVERHILL.

GEORGE F. MOORE, *Local Superintendent.*

The winter work in this city was vigorously prosecuted by the former local superintendent, Henry Frost, who carried on a very thorough campaign against the brown-tail moth in the early months of the year.

All the gypsy moth colonies were particularly cared for during the summer months, and during the fall the State inspector in charge of the district made a careful scouting of a large part of the city. As a result some 27 new gypsy moth infestations were discovered, the most important ones being on Main and Salem streets. The latter colony in the Bradford district occurs in an apple orchard, where much careful work will be required next year.

The work of 1907 should include the general use of the burlap wherever the gypsy moth has been found, while spraying can be done to great advantage in the principal infested districts.

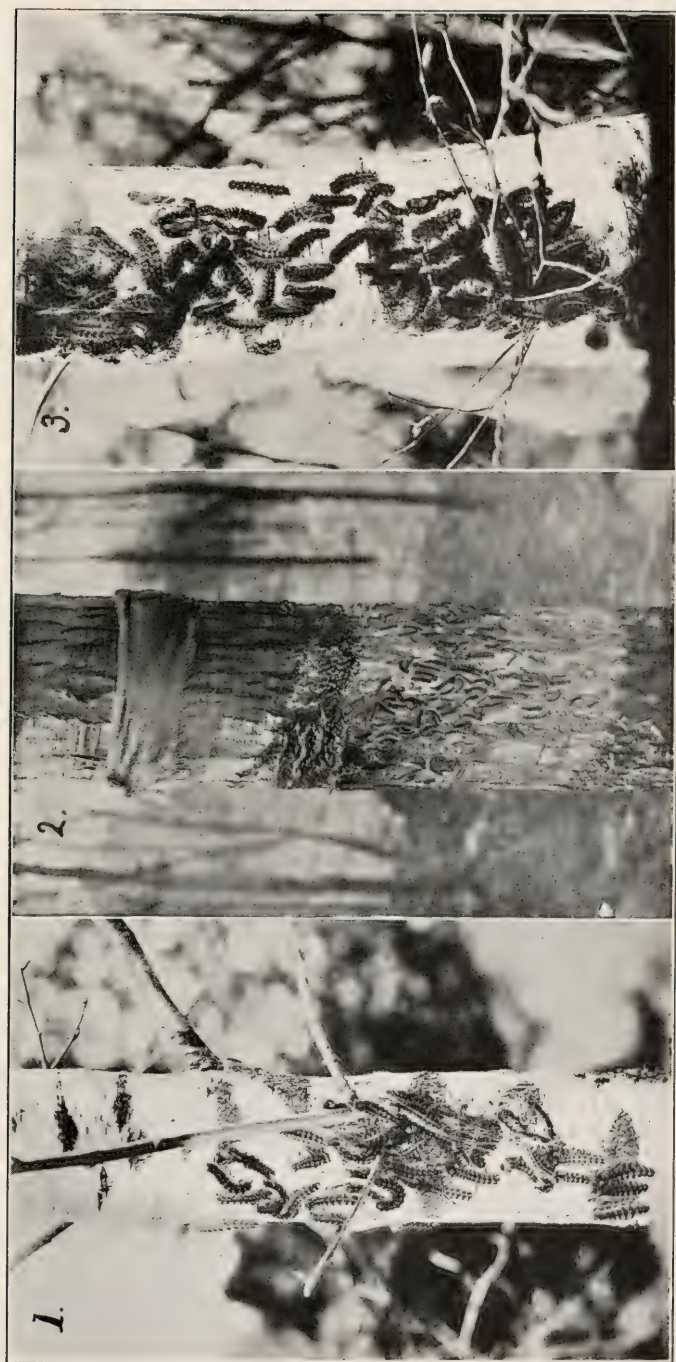
We are glad at this time to express our appreciation of the excellent work done by Mr. Henry Frost during the period when the field operations were in his charge. He co-operated fully with this office in carrying out our suggestions, and proved himself a most competent and energetic official.

HINGHAM.

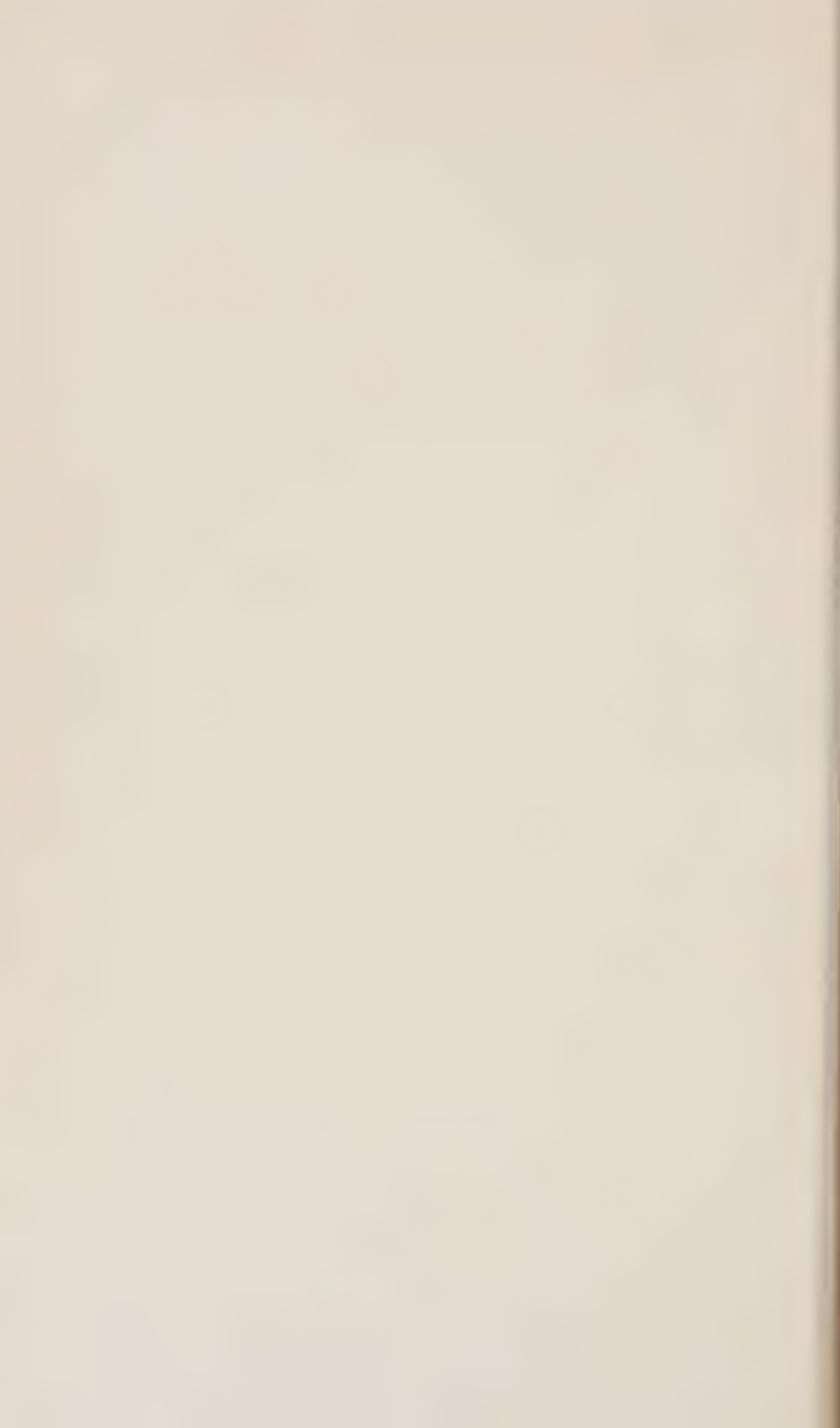
ARTHUR W. YOUNG, *Local Superintendent.*

At the time of making my last report the preliminary inspection of this town had been completed, and the gypsy moth found on almost every street. The winter work was carried out efficiently by the local superintendent, and during the caterpillar season upward of 1,500 street and orchard trees were burlapped and well attended.

In the important colony off Water Street the brush was cut, ground burned over and trees burlapped and thoroughly sprayed. This colony is somewhat isolated from adjoining woodland, and, as a result of the most excellent work done here, but 2 egg clusters have been found this fall, although upward of 10,000 caterpillars were taken at the first turn of the burlap. During the summer upward of 1,400 street trees were found infested



Figs. 1 and 3. Gypsy moth caterpillars clustered on white birch. Fig. 2. Caterpillars clustered below sticky band on red oak.



by gypsy moth caterpillars; but, as a result of the good work done by use of the burlap, only 150 were found infested at the time of the fall inspection. Brush along the infested roadsides has been cut, and the work of clearing street trees and scouting woodlands is now in progress.

The quality of the work at Hingham is entitled to highest praise, and equally commendable is the excellent support which the local superintendent has received at the hands of officials and citizens of the town.

HOLBROOK.

WILLIAM HAYDEN, *Local Superintendent.*

In the 10 gypsy moth colonies located last year upward of 800 burlaps were used; but, as a result of the good work done the previous winter, the caterpillars were taken in only 2 of the colonies. The local superintendent has carried out all suggestions made by this office, has cut and burned a number of worthless trees and cemented many others.

The infested orchards of this town should have special attention next season.

HOLLISTON.

FRANK CASS, *Local Superintendent.*

A slight infestation was found in this town during July, 1906, and a more extensive examination by Inspector I. C. Hildreth added materially to the number of infested estates. Wherever the gypsy moth has been found the necessary fall work has been done, and it is hoped that it will be possible to make a thorough scouting of the town before the caterpillar season of 1907. This scouting will be necessary in order to thoroughly develop the situation, and give us the data on which to base the season's campaign against the moth.

HOPKINTON.

OSCAR C. POND, *Local Superintendent.*

Work against the brown-tail moth was completed early in March, this insect being found generally scattered in small numbers throughout the town. The single gypsy moth colony previously noted was carefully attended during the season, with satisfactory results. The fall inspection by the local superin-

tendent has revealed 1 additional colony near the Ashland line, and 4 others at the center of the town.

The work of inspecting roadsides and orchards at this writing is still in progress. It will be desirable to have a thorough scouting of the entire town made at an early date.

HUDSON.

E. L. JEWETT, *Local Superintendent.*

Owing to lack of knowledge of existing conditions and failure to obtain experienced men, the town was not thoroughly cleared of brown-tail moth webs before the caterpillars emerged, although much good work was done in some sections.

The gypsy moth colony previously reported was thoroughly cared for during the season, all trees in the vicinity being burlapped and attended. As soon as funds permit, this town should be thoroughly scouted. If such scouting is not possible, the plan of work for 1907 should include the general use of the burlap on all trees in or near the known gypsy moth infestations.

HULL.

SMITH F. STURGIS, *Local Superintendent.*

This town, which contains the very popular summer resort of Nantasket Beach, is particularly liable to infestation from without, although the work of having it clear from the gypsy moth, were it not for this factor, could present no serious obstacle.

The street trees were well burlapped during the summer, although from scarcity of labor it was not possible to attend the burlaps as thoroughly as should have been done.

It is apparent, to any one familiar with the condition at Hull in 1905, that a great gain has been made in reducing the numbers of both the gypsy and brown-tail moths. There is need, however, for thorough work during the caterpillar season of 1907.

HYDE PARK.

HARRY G. HIGBEE, *Local Superintendent.*

Although this town covers only about $4\frac{1}{2}$ square miles, it has upward of 50 miles of streets and some 25,000 shade trees. There are about 125 gypsy moth colonies in the town, the most

important infestation being in a section known as "Grew's Woods," bordering the Stony Brook park reservation. All told, some 12,500 street and orchard trees were burlapped and well attended during the summer, while in certain sections infested brush was cut and ground burned with the oil flame.

A great gain has been made in reducing the moths in Hyde Park wherever work has been carried on, but the woodland colonies will require much careful attention in the future. In these sections the underbrush should be removed, dead and worthless trees cut and burned, and the woods thinned so as to permit of the economical use of burlap and spraying.

The work done by the local superintendent is entitled to the highest praise, and if properly supported in the future will continue to give good results.

IPSWICH.

W. QUINCY KINSMAN, *Local Superintendent.*

Owing to the late date on which work was commenced in this town, the local superintendent did not have sufficient time to thoroughly cover either the street trees or private property. The center of the town was, however, well covered, and the gypsy moth found in small numbers over the entire district.

Trees in the infested sections, both public and private, were sprayed and burlapped with the usual satisfactory results. At the present time the street trees and private property in the center of the town are in a most satisfactory condition, but on the outskirts much work yet remains to be done. The infested orchards require especial attention.

At the present writing badly infested brush is being cleared from the roadsides. In common with other towns in this district, it will be most desirable to have the woodlands thoroughly inspected as soon as funds are available.

KINGSTON.

DANIEL WESTON, *Local Superintendent.*

The infested orchards in this town present the worst problem, and there has been a general lack of interest apparent on the part of property owners, so far as assisting the local super-

intendent was concerned. These infested orchards should have most careful attention during 1907, if the gypsy moth is to be kept under control.

As far as funds permitted, the local superintendent has done good work in attending the burlaps in the known infested sections, and in removing worthless trees, cementing others, and carrying out the necessary operations as indicated by this office.

LAKEVILLE.

S. T. NELSON, *Local Superintendent.*

In the single gypsy moth colony found in this town the trees were burlapped and carefully attended, but no caterpillars were taken. The work of inspecting streets and orchards has been partially completed, but it will be desirable to make a very thorough inspection of the whole town as soon as funds permit.

The brown-tail moth infestation at Lakeville amounts to but little, very few webs having been found.

LAWRENCE.

ISAAC KELLEY, *Local Superintendent.*

At the date of the present report some 60 gypsy moth infestations have been found in Lawrence, and upward of 200 egg clusters have been treated. The most important infestation was in the vicinity of 19 Pearl Street, while an elm tree at 20 Berkeley Street showed upward of some 300 egg clusters. This city is peculiarly liable to infestation because of the main line of electric cars, which connects it with such badly infested sections as Reading, Wakefield, Melrose and Malden.

In Lawrence, while public-spirited citizens have been most active in promoting the work, there has been a marked apathy on the part of the city officials in providing funds sufficient to prosecute it. We have been at all times extremely desirous that Lawrence should not become so badly infested as to fall into the class of cities and towns like Arlington, Medford, Malden and Saugus; yet, if the policy of non-action is continued, there can be little question but that this city will soon become seriously infested.

LINCOLN.

EDWARD R. FARRAR, *Local Superintendent.*

A general inspection of the town, made in the early part of the year, showed the gypsy moth scattered throughout its entire area, while several important colonies were located in the woodlands. All the infested estates, aside from the woodland, were burlapped and fairly well attended during the caterpillar season. A few of the woodland colonies were also burlapped under an agreement with the property owners that they should attend to the work of caterpillar destruction. We regret to say that in most cases this agreement was not carried out, and the labor and expense of putting on the burlaps were practically lost.

In the nature of a summary, it may be generally stated that our work at Lincoln has gone far enough to show that woodlands and orchards are generally infested, while by far too many of the street trees harbor nests of the gypsy moth. If the pest is to be combated here and held in control, it will be necessary to cut brush along infested roadsides, thin the woodlands, and put the sections where the moth occurs in condition for effective and economical work.

There is much objection on the part of property owners, from reasons of sentiment, toward carrying out this plan of operations; but it will be necessary to work along the lines above indicated, unless the town is willing to make large appropriations for spraying operations at its own expense.

LITTLETON.

FRED O. STILES, *Local Superintendent.*

During September the roads and orchards in this town were thoroughly scouted by Inspector C. E. Merrill of this office, and 79 gypsy moth colonies were located, principally in the abandoned orchards.

The local work has been organized, and is being prosecuted vigorously.

LOWELL.

CHARLES A. WHITTET, *Local Superintendent.*

Early in the year, in certain parts of the city, there was a vigorous enforcement of the law with reference to the brown-tail moth. On account of lack of funds no thorough work has been done in Lowell against the gypsy moth, but operations against the brown-tail moth have been carried out in a most admirable manner, as far as local appropriations would permit.

During the fall and winter it was possible for inspectors and scouts employed by this office to make a thorough inspection of the city, and as a result some 900 infestations by the gypsy moth were found, which included 2 large colonies in the Pawtucketville section. In 1 of these colonies some 150 nests were found, and in another over 250. The finding of these infestations on the northerly side of the Merrimac River is most important with reference to the further spreading of the moth, not only in Massachusetts but also toward New Hampshire.

The plans for next season's work include the liberal use of the burlap, and in the badly infested sections much spraying should be done. It is only proper to say that, while at Lowell public-spirited citizens have appreciated the importance of promptly dealing with the moth, and while the local superintendent has endeavored in all possible ways to carry out our directions, efficient work has been very seriously hampered by lack of funds at a critical time, and the non-action, not to say apathy, of the city officials directly in charge of providing appropriations.

MARLBOROUGH.

M. E. LYONS, *Local Superintendent.*

The condition of this city shows no improvement over that of last year, owing in part to lack of funds at critical times, and in part from neglect of the local authorities to carry out the instructions of this office. The city was not thoroughly cleared of the brown-tail moth last winter, and at the present writing the condition of the outlying territory, particularly that along the Hudson line, is worse than it was in 1905. The con-

dition of the street trees is generally better than last year, but careless work by the owners of private estates, however, has been a serious handicap in clearing the moths from the residential sections. The general use of the burlap by the local superintendent in the Mount Pleasant section showed a considerable extension of the gypsy moth colony there located.

If the moths are to be kept under control in Marlborough, better and more timely work will be required in 1907.

MARSHFIELD.

W. L. SPRAGUE, *Local Superintendent.*

The preliminary scout of this town showed 9 gypsy moth colonies, and in them the trees were properly burlapped and well attended, only a few specimens of the moth being taken during the summer season.

The fall scouting by the local superintendent now in progress has to date shown 2 new moth colonies, and egg clusters in 2 of the colonies above mentioned, a total of 56 egg clusters having been found.

The orchards in this town will require careful attention.

MAYNARD.

LUKE S. BROOKS, *Local Superintendent.*

The single gypsy moth colony located in this town in 1906 was burlapped and well attended during the summer months, with good results. The fall examination of the town, which is now in progress by inspectors from this office, has shown 9 additional colonies in various parts of the town, which will require thorough attention next year.

The work against the brown-tail moth was done in a satisfactory manner early in 1906, and has again been practically completed at the present writing. It is hoped to have the town thoroughly scouted before the caterpillar season of 1907. Future work will include the usual cutting of worthless or hollow infested orchard trees, and the general use of the burlap during the caterpillar season.

MERRIMAC.

GILBERT G. DAVIS, *Local Superintendent.*

The work against the brown-tail moth was completed early in the year. At the School Street estate, where a single gypsy moth nest was found in 1905, the trees were burlapped and attended during the caterpillar season, but no caterpillars were found. In July a single gypsy moth pupa was found on an estate on Church Street.

At the present time the work of inspecting the street trees is progressing satisfactorily. The infestations by either moth in this town are at present of but small importance, but continued inspection will be necessary during 1907.

METHUEN.

A. H. WAGLAND, *Local Superintendent.*

The work in this town has been well conducted, and has at all times received proper financial support. Following the general enforcement of the law in the most seriously infested section last winter, there was a general use of the burlap on street and private trees wherever the gypsy moth had been found. There is hardly a town in the district which has shown a greater benefit from the use of the burlap. All the important colonies were sprayed, with excellent results.

The hearty co-operation of prominent citizens has been most helpful in this town, Mr. Tenney and Mr. E. F. Searles, among others, having materially assisted in our work.

Because of the number of automobiles passing through Methuen, this town has been a particular source of anxiety to the superintendent, and it is hoped that sufficient funds will be provided for a vigorous spraying and burlapping campaign the next season.

MIDDLEBOROUGH.

JOHN C. CHASE, *Local Superintendent.*

In the 3 known gypsy moth colonies located previous to 1906 the trees were burlapped and well attended during the summer, although no caterpillars were taken. A limited amount

of scouting was done in this town by an inspector from this office, with the result that 4 additional small colonies were located. The local superintendent then took up the work of scouting, and is adding a number of small colonies to the rest.

The problem of controlling the moth at Middleborough offers no special difficulties, aside from the large size of the town and great mileage of streets. We are assured that the colonies located will have proper attention next season.

MIDDLETON.

M. J. EMERSON, *Local Superintendent.*

The local superintendent continued the work of clearing private estates during the early part of the year, all being examined carefully for the gypsy moth, with the assistance of Inspector F. C. Worthen. Unfortunately, a large number of these estates were found to be infested. All shade trees and all infested trees on private estates were burlapped and carefully attended during the summer, with good results. It was possible during the fall to thoroughly scout the woodlands in the town, they being found generally infested, excepting in the northwesterly section. On Boston Street a colony of upward of 200 nests was found. The shade trees in residential sections show a marked improvement over 1905, but the woodlands will remain a source of anxiety until such time as funds are available for their treatment.

At the present time the work of cutting out infested roadsides is in progress.

MILLIS.

HARRY W. ALDEN, *Local Superintendent.*

In July a colony of the gypsy moth was discovered in this town near the main road to Medfield. Three men were promptly placed at work by the local authorities to thin out dead wood and underbrush, and about 1,200 trees were burlapped. Careful attention was given to the burlaps during the season, and upward of 1,000 caterpillars were destroyed. This colony will require a thorough cleaning this winter, and next season the

ground should be burned over and the trees burlapped and attended.

It would be well to have this town thoroughly scouted in the near future.

MILTON.

NATHANIEL T. KIDDER, *Local Superintendent.*

The work in this town has been excellently carried out under the direction of Mr. Kidder, and has had liberal support from the town officials and citizens.

The conditions as regards the gypsy moth in Milton offer a peculiar difficulty, in that most of the colonies occur on large estates, where much ornamental shrubbery has been planted. This makes it necessary to adopt methods which will eliminate the moth with the least possible damage to such plantings, and naturally the principal reliance must be placed upon spraying.

The trees in the infested localities have been burlapped and well attended, and a considerable amount of spraying has been done, brush along infested roadsides has been cut, and numerous decayed trees removed. As a result of the season's work the town is in a better condition as regards the moth pests than in 1905.

The winter work is well in hand, and next season the infested stone walls will be burned out. It is hoped that we shall be able to have the woodland along the border of the Blue Hills reservation thoroughly scouted at the beginning of the next caterpillar season.

NATICK.

HENRY S. HUNNEWELL, *Local Superintendent.*

Up to the close of the spraying season work in this town was carried on under contract, and included a scouting of the town, the burlapping of trees in the known infested localities and the general spraying of street trees. In the latter part of June Mr. J. L. Shaw was appointed deputy superintendent. He has carried on the work in a very satisfactory manner, under the direction of the local superintendent. All gypsy moth nests have been destroyed up to the probable snow line in nearly all the orchards and in the residential section. The fall inspec-

tion has shown a large number of infestations not developed in the spring scouting. Many orchards in the residential section have been trimmed, dead trees removed and cavities tinned, the cost of this work in many cases being paid for by the property owners.

There yet remains a large area of infested woodland, which should be thoroughly scouted before the caterpillar season of 1907. At the present time there are 394 known colonies of the gypsy moth in Natick, while during the season over 50,000 caterpillars and pupæ were destroyed, and upward of 3,500 new egg clusters treated last fall.

NEEDHAM.

ERNEST E. RILEY, *Local Superintendent.*

During the caterpillar season upward of 2,800 street trees and also those in colonies on private property were burlapped and carefully attended. In August and September Inspector Colin McIsaac made a preliminary scouting of the woodland, finding much of it infested by the gypsy moth. The clearing of town trees of the gypsy and brown-tail moth nests began on November 12, and is now nearly completed. The result of the scouting above mentioned will mean a great deal of work in this town next season; the woodland colonies should be thinned out and a large number of burlaps used. The work up to date has gone on in a very satisfactory manner, and has been well supported by the local authorities.

NEWBURY.

BENJAMIN PEARSON, *Local Superintendent.*

The thorough winter and spring work carried out by the local superintendent showed the brown-tail moth generally abundant, while numerous gypsy moth egg clusters were found in the Oldtown district. In the latter section there are a large number of orchards containing many hollow, worthless trees, which serve merely as a breeding place for the insects. If the owners of these trees do not value them sufficiently to clear them of the moth, they should be cut and burned, since their existence is a menace to the surrounding property.

The usual campaign of burlapping was carried on in Newbury with good results on street trees, but on private estates owners in many cases neglected to attend to them properly, and here in numerous instances the gypsy moth has increased in numbers. There are now known to be 113 infested estates in the town. At present the local organization is engaged in clearing the street trees, and when this work is completed the Oldtown section will have thorough attention.

NEWBURYPORT.

THOMAS T. UPTON, *Local Superintendent.*

All private estates in the residential section were cleared of both moths early in the year by the local superintendent, the gypsy moth being found, as last year, scattered throughout the city. Burlaps were generally applied and attended during the season, and a limited amount of spraying was done with effective results. Inspector Saul Phillips this fall located a large colony of upward of 1,000 nests on Lunt Street, which has been thoroughly treated by the local superintendent. It is only fair to say that this town shows a marked improvement over the condition of 1905, due to the efficient work of the local superintendent, and that the efforts of this office have received the hearty support of the local authorities.

At the present time Mr. Upton is prosecuting the work of clearing the street trees.

NORTH ANDOVER.

PETER HOLT, *Local Superintendent.*

Much work has been done in this town by Inspector John J. Fitzgerald, and as a result about 50 colonies of the gypsy moth have been located; in these colonies over 5,000 nests have been treated. The principal infestations occurred on the estates of F. H. Goodhue, B. O. Gray, George Stiles, D. T. Stiles, J. R. Murphy, Seth Farnham, Benj. Farnham and Daniel Carleton. Those familiar with this town will recognize that the infestation occurred mainly in its southern part.

The many other important business duties of the local superintendent prevented him early in the season from giving to this

work the attention which it deserved. At our suggestion, he deputed an assistant to take immediate charge of the field operations, and under the latter's direction decayed apple trees have been cut, infested trees tinned and cemented, and the most important colonies put in good condition for next year's work.

It is the opinion of the superintendent that no single method will yield such good results as a vigorous spraying campaign in North Andover during the coming season. Infested street trees and orchards, together with those in the vicinity of the infestations, should be thoroughly sprayed; and if suitable labor can be provided, a general burlapping of all the trees in the infested spots and their neighborhood should be carried out.

NORTH READING.

F. W. MOSMAN, *Local Superintendent.*

The gypsy moth infestations located in this town by our preliminary scout of 1905 have been well cared for, but the problem of dealing with the infested woodlands is still *sub judice*. The local superintendent has burlapped and well attended the trees in the infested sections, and has cut a considerable amount of infested brush along the main highways. So far as the street trees and residential section generally are concerned, there has been a notable improvement in this town.

It is much to be regretted that the condition of our finances has not permitted of a more vigorous campaign against the moth throughout the entire infested district of this town.

NORWELL.

JOHN H. SPARRELL, *Local Superintendent.*

At the time of making my last report only the street trees in this town had been inspected, except for some orchard examinations near Accord Village. When the inspection of private estates had been completed, nearly 70 places infested by the gypsy moth had been found in various parts of the town. In all these colonies the trees were burlapped, but it was difficult to secure proper attention to the burlaps during the summer; in consequence, we cannot report as much progress in suppressing the moth at Norwell as would otherwise have been

the case. There has been a large increase in the number of egg clusters, both on street trees and in old, neglected orchards. More thorough work must be done in this town next season, if the moth is to be brought under control. The orchard problem here is the most difficult one, and should have careful attention.

NORWOOD.

FRANK H. WINSLOW, *Local Superintendent.*

The condition of this town remains about the same as in 1905. The infested trees were burlapped, but were not thoroughly attended, and as a result little if any gain has been made in suppressing the gypsy moth. Better local work will be necessary here in 1907, and more vigorous efforts should be made by property owners in the work of clearing neglected orchards.

ORLEANS.

GEORGE JORDAN, *Local Superintendent.*

The single gypsy moth colony found here early in the year by an inspector from this office has received proper attention during the past season. The trees in the vicinity of the infestation were burlapped, but no caterpillars were taken. It will be desirable to have this town scouted at an early date.

PEMBROKE.

CALVIN S. WEST, *Local Superintendent.*

The trees in the 27 gypsy moth colonies located in this town were properly burlapped and attended during the caterpillar season, with good results. A careful inspection was made of the town last fall, and, as was expected, a number of important orchard colonies were found. At the close of the year over 100 estates were found to be infested, and some 1,400 gypsy moth egg clusters destroyed. In nearly every instance the colonies are located in or near neglected orchards. The local superintendent is now at work removing worthless trees, cementing cavities, etc., in order to put the infestations in proper condition for next season's work.

PLYMOUTH.

GEORGE R. BRIGGS, *Local Superintendent.*

Some 2,500 burlaps were used on the trees in the gypsy moth colonies located previous to the caterpillar season of 1906, and larvæ were taken at four places. Soon after the first of November the local forces commenced scouting the streets and orchards of the town, and found scattering nests in various localities. One seriously infested orchard of some 4 acres was located on a path leading from the village to the Worster Mills, and thence to the summer cottage section at Billington Sea. This is probably the most important infestation in the town, and should have careful attention. A few egg clusters have been found at various points near the ponds, and it will be important to have a thorough inspection made of the town at an early date. The work here has been well carried on and properly supported by the local authorities.

PLYMPTON.

ZINA E. SHERMAN, *Local Superintendent.*

In this town, while the trees of the infested section were properly burlapped, they did not receive suitable attention during the caterpillar season, and as a result our fall inspection showed some 32 infested estates, with a total of 404 gypsy moth egg clusters destroyed. It is hoped that the results of this inspection will sufficiently arouse citizens of the town to the importance of clearing up their infested orchards, and of inaugurating a more vigorous campaign against the moth.

RANDOLPH.

ROYAL T. MANN, *Local Superintendent.*

At the beginning of the caterpillar season 12 colonies of the gypsy moth were located, 2 of them being in woodlands. In the latter places the brush was cut and the necessary preliminary work done. The infested trees were burlapped and well attended. The fall examination, made with the assistance of an inspector from this office, showed some 50 new infestations, and as a result

the town cannot be considered as having shown much of a gain in the work against the moth in 1906. A more vigorous campaign will be necessary next year, if progress is to be made. There are three main lines of travel through this town, and in consequence it is peculiarly liable to infestation from outside sources.

RAYNHAM.

GEORGE M. LEACH, *Local Superintendent.*

An inspector was detailed to make a careful examination of the main line of travel between this town and Brockton during the fall months, and as a result 1 small gypsy moth colony was located. This has been properly cared for. The local superintendent is engaged in making an inspection of all street and orchard trees in the residential district, and to date has made no additional findings of the moth.

ROCKLAND.

FRANK H. SHAW, *Local Superintendent.*

About 25 estates infested by the gypsy moth were found in this town early in the year, and the trees in all of them were burlapped and attended during the caterpillar season, with good results. The fall inspection now in progress by the local superintendent shows some 30 infested estates, due in nearly every case to neglected orchard trees. We have assurances that all necessary work to put these infestations in good order will be done before the caterpillar season of 1907.

ROCKPORT.

ELI GOTT, *Local Superintendent.*

But little work in this town has been done by property owners, and it is most fortunate that the local superintendent has shown such a high degree of efficiency in carrying out plans for suppressing the moths. Mr. Gott completed the work of clearing private estates early in the year, and his inspection corroborated that made by this office in 1905, which showed the town scatteringly infested by the gypsy moth. The infested sections were put in proper condition, burlapped and well

attended by the town organization during the summer. A few badly infested places were sprayed, and it was necessary in many sections to thin trees and cut brush along the roadside. A large number of caterpillars were taken in the infested orchards during the larval season. The fall inspection shows that street trees and those on private property are in much better condition than in 1905. A thorough examination of the woodland will be necessary in the near future, and it seems probable that many scattering gypsy moths will be found there.

In this town there is a greater need of co-operation on the part of citizens in clearing their own property, if the work is to be brought to a successful issue.

At the present time the work of clearing town trees and thinning trees in Manning Park is in progress.

ROWLEY.

DANIEL O'BRIEN, *Local Superintendent.*

In this town property owners showed a general disposition to comply with the requirements of the law, and to clear their orchard and other trees of the brown-tail moth. The local superintendent supplemented this work by inspection and careful examination for the gypsy moth, with the result that many orchards were found infested. Wherever the latter insect was found, burlaps were used to good advantage during the summer; and during the fall months a considerable amount of cutting of brush along roadsides was accomplished. Mr. O'Brien discovered a colony of about 2,000 nests on the Stack Yard Road early in the fall, and here the brush has been cut and burned, trees thinned, and everything possible done to prepare for thorough work next season. Plans for the future involve a thorough scouting of the town, the cutting and burning of numerous hollow trees, and the cementing of cavities in orchard trees which are worthy of preservation.

The work here has been well cared for, and the general condition of street trees and those in residential sections is much improved over that of 1905.

SALISBURY.

HENRY C. RICH, *Local Superintendent.*

The general infestation of the town continues, the principal gypsy moth colonies being, as elsewhere, in the old, badly infested apple orchards. The infestations located previous to the caterpillar season were burlapped and carefully attended during the summer. Much excellent work has been done by the local superintendent in destroying brown-tail moth webs and in the summer and fall operations. If it were possible to thoroughly clear the orchards of the gypsy moth, cut the hollow and worthless trees and cement the cavities in the trees remaining, following up this work by burlapping during 1907, a great gain should be made in suppressing the moth.

At the present time the work of clearing the town trees and cutting and burning infested brush is in progress.

SANDWICH.

JOSHUA E. HOLWAY, *Local Superintendent.*

On December 28 the local superintendent found a small gypsy moth colony, containing 12 egg clusters, in the Spring Hill district. The work of completing the inspection of this town is in progress.

SCITUATE.

JETSON WADE, *Local Superintendent.*

Excellent work was done in this town against the brown-tail moth early in the year, and the gypsy moth infestations located were properly cared for. Scituate is peculiarly liable to infestation from outside sources, because of the large number of summer visitors to the town and the consequent driving and automobiling through it. There is a small gypsy moth colony on Second Cliff, which is the most important infestation yet found in the town.

The local superintendent and Inspector Wight of the central office have been able to do a limited amount of scouting along the streets and in orchards, and the fall inspection is now in progress. The most difficult problem in Scituate will be the clearing of the moth from the neglected orchards, and this work should be prosecuted vigorously.

SHERBORN.

WALTER CHANNING, Jr., *Local Superintendent.*

There are at the present writing 18 known gypsy moth colonies in this town, 7 of these being in the woodland. With the exception of those last found, all have been put in good condition for exterminative work, the brush and worthless trees have been cut and burned, the ground burned over and cavities in orchard trees properly closed. During the summer the known infestations received careful attention, with good results, upward of 3,500 burlaps being used, and over 12,000 caterpillars being destroyed.

This town should have a thorough inspection at the earliest possible date.

SOUTHBOROUGH.

HARRY BURNETT, *Local Superintendent.*

Excellent work has been done in this town against both moths, under the direction of the local superintendent, who has taken a great interest in the work. Near the Marlborough line the infestation by the brown-tail moth has been quite severe. The single gypsy moth colony located in 1905 was carefully attended to during the summer. Just previous to the close of the year it was possible to have this town thoroughly scouted, under the direction of Secretary J. A. Farley of this office, with the result that small infestations were found in various parts of the town. These widely scattered colonies will require careful attention during 1907, and this we are assured the local authorities are ready to provide.

STOUGHTON.

WILLIAM P. KENNEDY, *Local Superintendent.*

There has been but little trouble with the brown-tail moth at Stoughton. The trees in the known gypsy moth colonies were burlapped and attended during the summer, and a few scattering larvæ were found. A careful inspection was made this fall of these colonies, and two egg clusters were found on an estate adjoining the Pleasant Street colony. At the present writing over one-third of the residential section of the town has been scouted, and two new colonies found, neither of them containing many egg clusters.

The infestation recently located on Summer Street is near woodland, and will require particular attention during 1907.

The local superintendent has carried on the necessary work in a very satisfactory manner, and, if properly supported by local appropriations, should have no difficulty in holding the known infestations in check.

STOW.

JAMES E. WELCH, *Local Superintendent.*

Some 30 colonies of the gypsy moth have been located in this town by inspectors from this office. The single colony found in 1905 was burlapped and well attended during the season. It will be necessary to have all the colonies put in good condition for next summer's work, the one at the Red Acre Farm requiring the principal attention. This colony is a good illustration of how the moth is spread by means of traffic. To this farm large numbers of horses are brought for boarding during the summer months, and this travel from badly infested centers is no doubt responsible for the presence of the moth here. Next season's work should include a large amount of burlapping, and possibly some spraying.

SUDBURY.

WILLIAM E. BALDWIN, *Local Superintendent.*

The gypsy moth colonies previously located here were carefully looked after during the season, and but few caterpillars were taken in them. Fall cleaning work up to the probable snow line has been done throughout the town, and this will be continued by a thorough cleaning of the trees. There are now about 150 infested estates in Sudbury, which indicates the wisdom of making a thorough examination of the woodlands at the earliest possible date. Next season the general use of the burlap will be necessary.

TEWKSBURY.

CHARLES K. FRENCH, *Local Superintendent.*

The three gypsy moth colonies located in this town in 1905 were all carefully burlapped and attended during the caterpillar season, with good results. It was possible this fall to make a quite thorough inspection of the town, with trained assistants

employed by this office. As a result of this examination, gypsy moth nests were found scattered on nearly every street or road of the town, while the woodland appears to be generally infested.

An important colony has been discovered on Lee Street, near the center of the town, where upward of 2,000 moth egg clusters were found and treated. The underbrush in the vicinity has been cut and burned, and the ground burned over with oil for a slight distance from the roads. Throughout the town a general campaign of cutting and burning worthless roadside brush and trees has been followed, and as a result it is not anticipated that there will be any great scattering of the moths from the infested sections next year.

TOPSFIELD.

C. W. FLOYD, *Local Superintendent.*

The winter and early spring work of the local superintendent showed the gypsy moth lightly scattered over the town. Property owners as a rule did the necessary work against the brown-tail moth, but, not being familiar with the gypsy moth, often overlooked the latter. All known infestations were burlapped and attended during the caterpillar season, with good results. In September Inspectors F. C. Worthen, F. W. Parkins and the local superintendent thoroughly scouted the woodlands of the town, finding the gypsy moth nests in all sections. On the northerly side of the Ipswich River upward of 230 nests were found in two acres of woodland between Rowley and Bridge streets and the Middleton line. This is the most important infestation yet discovered in the town.

The town as a whole, aside from woodlands, is in an improved condition over that of 1905, but the colonies located to date will require careful attention in 1907. At the present time the work of clearing infested roadsides is in progress.

TYNGSBOROUGH.

A. R. MARSHALL, *Local Superintendent.*

As the result of the scouting in this town in September by Inspector C. W. Lewis, some 30 small gypsy moth colonies were located. None of these colonies are of great importance, aside

from the fact of their location on the border of the infested district.

The work against the brown-tail moth was well done early in the year, and at the present writing the work of clearing up the gypsy moth infestations is in progress.

While the amount to be expended next year in this town will be relatively small, at the same time it seems to the superintendent of vital importance that everything possible should be done to exterminate the gypsy moth colonies which have been found.

WAREHAM.

JAMES J. WALSH, *Local Superintendent.*

The trees in the 3 gypsy moth colonies located in this town last year were burlapped and attended during the summer, and 3 pupæ were found. It was impossible to commence the fall inspection until after the close of the work on the cranberry bogs, owing to the scarcity of labor.

It has been planned to have the streets and orchards of the town thoroughly examined during the fall and winter months.

WAYLAND.

GEORGE W. FAIRBANK, *Local Superintendent.*

The general infestation of this town continues, and much careful work will be necessary in the future, if any headway is to be made against the gypsy moth. Many worthless trees in infested orchards have been cut and burned, while tinning and cementing has also been generally followed with good results. The trees in the known infested districts were burlapped and attended during the summer, with generally good results.

There has been but little gain in the work against the brown-tail moth at Wayland, largely due to careless work on the part of property owners during the previous winter. Small colonies of the gypsy moth are known to exist in various places in the woodland, which indicates the necessity of making a thorough scouting of the entire woodland area at an early date.

WELLESLEY.

FLETCHER M. ABBOTT, *Local Superintendent.*

The work in this town has been carried on vigorously by the local superintendent. Aside from the usual winter work, all street trees were burlapped, also those bordering the streets on private property. The continued examination of the burlap during the summer developed several new gypsy moth colonies. Following the larval season, brush along infested roadsides and stone walls in infested sections was cut and burned. A general scouting of the woodlands was undertaken as soon as the leaves had fallen, — work which could be carried on to unusually good advantage, owing to the fact that much of the woodland is nearly free from brush and small growth.

In certain isolated woodlands some cutting has been done preparatory to burlapping work next season. The very serious problem of combating the gypsy moth has developed in the extensive woodland locally known as the "Hundreds." Throughout this section the moth occurs in scattered numbers, quite evenly distributed, and a considerable amount of money must be spent here to hold it in check. Next season's work should include the general use of the burlap, spraying in certain badly infested districts, and a limited amount of burning with the oil flame in certain important colonies.

WENHAM.

J. D. BARNES, *Local Superintendent.*

Early in January the local superintendent commenced work against the moths on private property, with the discouraging result of finding the gypsy moth on nearly every street in the town. In many of the infested apple orchards the worthless trees were cut and burned, this being followed up by spraying during the caterpillar season. All infested trees on private estates, together with the shade trees throughout the entire town, were burlapped and attended, with the usual good results.

At the present time the clearing of infested roadsides in the eastern section of the town is in progress. Aside from the woodlands, this town is in an improved condition, compared with

1905. The woodlands yet remain an unknown factor, but sufficient scouting has been done in them by our inspectors to show that the gypsy moth is generally scattered throughout their entire area.

WESTBOROUGH.

CHARLES S. HENRY, *Tree Warden*.

The gypsy moth colony found in August in Westborough by Inspector C. E. Merrill consisted of 4 estates near the center of the town, while another slight infestation was located in the southeastern part of the town. Owing to the prompt action by local authorities, both these colonies have been cleaned up, trees trimmed, cavities in infested trees cemented, and everything possible done preliminary to next season's work. It is planned to give this town a thorough scouting before the opening of the next caterpillar season.

WEST BRIDGEWATER.

H. M. HOWARD, *Local Superintendent*.

At the gypsy moth colony located in this town in 1905 a single caterpillar was found during the summer. An inspector from the central office, together with several of the town employees, commenced scouting the town at the close of the caterpillar season, and some 10 small colonies were found. There have been several changes in the office of local superintendent, which to some extent have worked against the best interests of the local moth campaign. The work is going on well at present, and it is not expected that any large gypsy moth colonies will be found in the town.

It will be necessary next season to give particular attention to the neglected orchards in which the moth has been found.

WESTFORD.

JAMES SPINNER, *Tree Warden*.

In the fall a careful inspection was made in this town by means of trained men employed by the central office. Upward of 400 gypsy moth egg clusters were found and destroyed in various parts of the town, — a sufficient number to indicate that, while the infestation was slight, it was very gener-

ally scattered. This town now becomes one of those in which particularly careful and thorough work will be required to destroy the moth colonies on the border of the known infested district.

WEST NEWBURY.

WILLIAM MERRILL, *Local Superintendent.*

The local superintendent completed early in the year the work of destroying the brown-tail moth nests, and found several small gypsy moth colonies. The infestations located up to the caterpillar season were given thorough treatment. This was followed by the use of burlap during the summer, but very few caterpillars were found. The operations in this town have had constant care and good direction. An examination of the woodlands at an early date is desirable. At the present time work of clearing the street trees is in progress.

WESTON.

EDWARD P. RIPLEY, *Local Superintendent.*

Work in this town has continued under favorable auspices, and has been vigorously prosecuted by the local superintendent.

The general inspection made by the local force during the early part of the year showed that the gypsy moth was scattered in varying numbers over nearly the whole town, although but few were found in the section adjoining the Lincoln-Wayland lines. This latter fact is of particular interest, because of the close proximity of this section to the old colony in Lincoln, located in 1898-99. During the summer burlap was used on the street trees and on the principal infested private estates, and a most commendable effort was made by private citizens to assist the local superintendent in his work. Following the burlap season, a number of badly infested white oaks were scraped and put in good condition for next year's work, the worst-infested orchards were trimmed, cavities cemented, and the principal infested roadsides cleared of brush. The fall inspection, made by the local superintendent in the northern part of the town, developed several new infestations, yielding upward of 5,000 nests.

The work in this town practically resolves itself into a woodland problem, since over half the town consists of a heavy growth of woods. If the present efficient work can be continued, together with co-operation on the part of property owners, much gain should be made against the moth in 1907.

WESTWOOD.

C. H. SOUTHERLAND, *Local Superintendent.*

In the single gypsy moth colony located in this town in 1905 burlap was used to good advantage during the summer. Inspector Curry of this office spent a considerable amount of time scouting the principal streets, and located a small colony on Gay Street. Another colony on Clapboard Tree Street was reported by the owner of the property, and has been thoroughly cleared. More scouting is necessary to determine the exact condition of this town with regard to the moths, and a considerable amount of work will be required in the known infested sections.

WEYMOUTH.

DUMMER SEWALL, *Local Superintendent.*

The inspection of 1905 and the early part of 1906 showed the gypsy moth generally scattered over the entire town, the principal infestations being in the north and east villages. All street trees were burlapped and well attended, and trees on infested private estates were burlapped, with the understanding that the property owners would do the necessary work. Not over 10 per cent. of them have given the burlaps any attention, and as a result these estates do not show the improvement which might otherwise have been expected. The local force has scouted the entire residential section, and is now at work examining the woodlands. Scattered nests have been found almost daily since this work began. A considerable amount of brush and worthless trees have been cut along infested roadsides.

It is apparent that the numbers of the moth on street trees have been greatly reduced, but there has been some increase of the pest on neglected private estates. Better co-operation on the part of the citizens will be necessary, if permanent headway is to be made against the moth in this town.

WHITMAN.

CLARENCE A. RANDALL, *Local Superintendent.*

There has been some difficulty in securing proper labor to do the necessary work at Whitman, but as a result of the scouting operations some 24 estates infested by the gypsy moth have been located. The trees in all these estates were burlapped and well attended during the summer. The fall scouting is in progress, and will be completed before the next caterpillar season. A number of badly infested orchards will require trimming, cementing and possibly spraying during the year, while the burlap should be generally used wherever the moths have been located.

WILMINGTON.

OLIVER MCGRANE, *Local Superintendent.*

This town is thoroughly infested by the gypsy and brown-tail moths, and, while as yet none of the colonies are of notable importance, the general scattering of the moths throughout the town will be a constant source of anxiety until the infestations are destroyed. The work against the brown-tail moths early in the season having been completed, the local superintendent burlapped all the trees in the districts known to be infested by the gypsy moth, with excellent results. Following this work, much underbrush and many defective trees in badly infested sections were cut and burned. This town presents a serious orchard problem. It has been necessary to cut and burn numerous decayed, infested trees, and to cement or tin the cavities in a very large number of those remaining.

Next season's work, if only limited funds are available, should include a very general spraying of all infested orchards, and the use of burlap on street trees throughout the town.

YARMOUTH.

CHARLES R. BASSETT, *Local Superintendent.*

Good work was done in this town against the brown-tail moth in the early part of the year, while later the single gypsy moth colony received good attention. The burlaps were well attended, but no caterpillars found. Some scouting has been done outside the colony, but no further infestations have been discovered.

SUMMARY OF CONDITION OF TERRITORY.

As previously pointed out, much progress has been made in clearing the gypsy moth from the street trees and residential districts, — a condition of affairs well borne out by statements from interested property owners and others familiar with the conditions as compared with those of one year ago. The central towns remain quite thoroughly infested, but the control of the moth in residential districts offers no notable obstacle, provided thorough suppressive measures can be continually enforced, and suitable work can be inaugurated in the infested woodlands. While the funds available for the work during the year were sufficient for the field operations undertaken, it is greatly to be regretted that so little was possible in the way of clearing the moth from woodlands, or at least isolating the principal woodland colonies. Beyond the border of the central infested district there are important infestations at Braintree, Dedham, Natick, Framingham, Concord, North Reading, Andover, and throughout the entire eastern part of Essex County. In many cases these outlying infestations have received the necessary preliminary treatment, but an enormous amount of work yet remains to be done, if the moth is to be brought under control and prevented from increasing in numbers.

The area occupied by the brown-tail moth apparently remains about the same as that of last year, and owing to the marked epidemic of disease among the caterpillars, mentioned elsewhere in this report, the numbers of this insect, broadly speaking, show no material increase. Its principal spreading still continues along the coast line both to the north and south of Boston, but more particularly toward New Hampshire and Maine localities.

The time has come when a decision should be reached as to some definite policy in regard to the treatment of the large woodland areas infested by the gypsy moth. The moth can be controlled in the woodlands at a moderate expense, provided some definite system of action is arranged for and properly supported by suitable appropriations. This will require time and a considerable outlay of funds, and should not be undertaken except on the basis of a plan of work which shall be carried on over a term of years.



Upper view, neglected pear orchard, Winchester, stripped by brown-tail moth caterpillars, June, 1905. Lower view, same orchard, properly cared for, 1906.



STATEMENTS OF CITIZENS.

As showing what has actually been accomplished in various infested localities the following statements from prominent citizens are of interest:—

JUDGE W. E. LUDDEN, CLIFTONDALE.

From my piazza you can see on Baker's Hill several dozen dead oaks of good size, killed by the gypsy moths. They were stripped for several years, and last season finished them. Had there been no work last winter by the moth employees on Baker's Hill it is my opinion that the rest of the trees would have been killed. My place adjoins Baker's Hill, and we were fairly overrun with caterpillars of the gypsy moth. They swarmed on the walks, piazza, flowers and sides of the house day after day.

There has been a good deal of work done in Saugus by the moth employees, and as a result conditions have improved on Baker's Hill and in my part of the town generally, as doubtless they have elsewhere; but in the north part of the town the woods are in bad shape. I believe this bad woodland condition to be due to the fact that neither owners nor town can afford the money necessary to check the moths in the woods.

AUG. 1, 1906.

CAPT. C. A. HARRADEN, ENGINE 5, LYNN.

I have seen the city men working steadily against the moths on the street trees. They deserve great credit for the good work they have done. The common remark in the city is to this effect. For two years previous to this year the moths were specially numerous in this section. Across the street from us the foliage on the fruit trees was entirely eaten, and the top of a cherry tree is dead in consequence. During the flying season of the brown-tail millers it was almost impossible of an evening to see the arc light in the front of the building, so whitened was it by the insects. This year I have seen only three or four around the lights.

AUG. 1, 1906.

ALDERMAN L. F. HOLDER, LYNN.

Over the city of Lynn at large a gain has been made against the moths in the residential sections. I can see a great change for the better. Previous to this year, when the brown-tail moths were flying, some of the large store windows on Market Street looked as if they were covered with snow, where the moths had lit. The electric light pole at the corner of our street looked as if it had been painted white. The Tapley woods in our neighborhood, which previous to this year were badly eaten, are this summer in very good condition.

Unlike past years, we have had no suffering from the brown-tail rash. The city men cut off the winter webs in the spring in the Tapley woods.

They have done good work all over the city. In this neighborhood individual effort against the moths has been excellent.

I have two acres of woodland on Linwood Street which last year were badly eaten by the caterpillars; this year I cannot detect any sign of stripping there.

While the city laments the expenditure against the moths, we know the necessity of it, and do not grudge it.

AUG. 1, 1906.

WILLIAM STONE, SUPERINTENDENT, PINE GROVE CEMETERY, LYNN.

It is either trees or gypsy moths, — you cannot have both. I was not much troubled last year with gypsy moths in Pine Grove Cemetery, but the cemetery adjoins the Lynn public woods for a good part of its line, and so we were exposed to invasion by the gypsy caterpillars from three sides. This year they came in on us. I made up my mind that visitors to the cemetery should not go away shocked at the sight of the moths' ravages. Last winter we creosoted all egg clusters possible, and this spring we put burlaps on the trees, and tended them. I had pans cut so as to fit the tree trunks. Equipped with these, the workmen would brush the caterpillars from the burlaps into the pans, and thence into the pails of kerosene. Two men worked steadily destroying moths all summer, and I would turn my whole force of 40 men on to the work for half a day per week on an average. My men destroyed in all from 35 to 40 bushels of caterpillars. One man destroyed 18 bushels. To-day you cannot find a tree defoliated in the cemetery. We have 60 acres, with trees in plenty and variety, but the vigilant work prevented a single tree from being stripped.

As to brown-tail moths last summer, of an evening the whole sides of some of our buildings in the business section were white with millers. You could no more count them than you could number the stars in the heavens. This year I haven't seen one miller.

I think Mr. Doak, who had charge of the city work, has done excellently on the street trees. His men have sprayed to good effect, and have tended their burlaps faithfully.

AUG. 1, 1906.

GEORGE E. HITCHCOCK, CITY TREASURER, MALDEN.

There has been in my section a very great improvement in regard to the moths. Two years ago they were perhaps at their worst. My house, at the corner of Glenwood and Bartlett streets, was overrun with caterpillars; they were over everything. They would come up between the boards of the piazza, and we would go out in the street with brooms and crush them wholesale. I worked by night and by day, and so did others. Nearly everybody worked with might and main. This year I have not seen one caterpillar on my house. I believe the good condition

to-day proves that, if citizens work together in co-operation with the city work on the trees in streets and parks, the moth nuisance in Malden can be handled. At one time I was inclined to doubt if this could be done, but our efforts in my neighborhood have led me to think differently. As to brown-tail moths, I have heard of but few cases of rash this year. I think the city work in Malden has been well done.

AUG. 1, 1906.

C. E. MANN, MALDEN.

During the period from about June 1 to the middle of July, 1904, the section in Malden in the vicinity of Hawthorne and Dexter streets and Woodland Road was the center of a very active colony of gypsy moths, although the trees of all residents in that locality had been carefully cleaned, and were banded and sprayed. The fact that it was surrounded on two sides by open lots on which there was a heavy growth of oak and walnut trees, and that one of these lots had received no attention from the time the State gypsy moth work had been abandoned, led to the reinfesting of all the trees in the neighborhood. The small caterpillars, as soon as hatched, were blown by the wind over the trees which had been cleaned, and as time went on and the foliage was stripped from the trees in the open wood lots, the full-grown caterpillars swarmed to the grounds where the work of cleaning had been done. As a result, I took from the fourteen trees on my own premises and from the stone work and piazza of my house an average of about one and one-half pecks of caterpillars daily through a period covering five or six weeks. These were brushed from below the bands on the trees and elsewhere into some receptacle and then burned, the funeral pyre making a mound of ashes something like a foot high and two feet in diameter.

My neighbor, Judge Bruce, came home from a yachting trip one night in the early part of July, and was surprised to find it impossible to walk up to the piazza of his house without crushing dozens of caterpillars on his steps. It became necessary to place a "dead line" of bodlime completely around Judge Bruce's house and his doorsteps, to prevent the caterpillars from taking entire possession. I also had a dead line of the same nature around my own house; but notwithstanding these precautions it was necessary for a long time to get out my garden hose every morning and wash the caterpillars from the wood-work on the upper part of the piazza and the sides of the house.

The work that was done at that time greatly lessened the number of caterpillars one year ago, and during the present summer careful work in cleaning the trees has protected the foliage. One of the open lots referred to has never been cleaned by the owner (although the center of the colony) since the State work was abandoned until last spring, when employees of the city cleaned the trees and cut away the underbrush, but from lack of time were unable to burn over the ground, the consequence being that the foliage on this lot is about half devoured,

while those of us who are neighbors have had to do work daily in destroying the caterpillars which crossed the street and visited our trees.

Four summers ago there was a proportion of about 90 brown-tail moths to 10 gypsy moths in every 100 caterpillars I destroyed. The following summer this proportion was exactly reversed. During the past summer I do not think I have seen a dozen brown-tail caterpillars on my premises.

There is no doubt that conditions on my place are very much better than last year, and especially two years ago. So far as I have seen, the city work on the street trees has been well done.

AUG. 1, 1906.

FRANK R. SIRCOM, TREASURER, MALDEN TRUST COMPANY, MALDEN.

Two or three years ago the gypsy moth caterpillars were a great nuisance in my neighborhood; they simply swarmed. I recall a tree that was so loaded with them that people would stop and look at it, as a curiosity. The larger trees on Glenwood Street and in the section next to the Staples house were stripped clean. To-day these trees are in good foliage. We have caterpillars, but they cannot ascend our trees, on account of the sticky bands. My apple trees, which in the past were stripped in the course of the summer and then leaved out again, have scarcely had their leaves riddled this year. So far as I am able to discover, the city work has been well done. I believe that if the State continues work along the lines laid down, unceasingly and without any let-up, the practical extinguishment of the gypsy moth can be brought about; but there must be no cessation in the work for a long time to come.

AUG. 1, 1906.

W. B. SOUTHWORTH, MALDEN.

Last year we crushed the caterpillars as we walked on the sidewalks, and the year before they were even worse than this. We could hear the sound of their "munching" up in the trees. The gypsy caterpillars got into the shrubbery, on the piazzas, sides of the houses, etc., — were a perfect nuisance, in fact. To-day there are only a few in our neighborhood, and no stripping of the trees is visible on Beltran Street, where I live.

Last year there was a great demand for lotion for brown-tail poison, and I sold a lot of it. This year only three or four cases of poisoning have come to my notice.

The city work under Mr. Powell's direction has been very satisfactory to the citizens.

AUG. 1, 1906.

CHARLES G. WARREN, MAYOR, MALDEN.

The moth situation in the city is much improved. Less caterpillars are to be seen, and there have been less signs of stripping. Having a State superintendent with general oversight of operations has been of

great benefit to the moth work. We have had the benefit of his experience and advice, and there has been a coherent plan of campaign, which has made for more efficient work all along the line. While the city of Malden has done a good deal against the moths in the past few years, the passage of the State law last year and the assumption of a general oversight and control of the work have certainly pushed things. The fact that we have spent more money in the moth work than ever before, being by the State law compelled so to do, has naturally brought about greater results.

As to private work against the moths, I do not think that as much has been done by citizens this year as last year, and less last year than two years ago. In many cases people have waited for the city to step in and do the work for them. Then, the fact that the neglect of a few to do anything on their estates caused re-infestation of adjoining yards where people had worked hard to clean things tended to discourage further effort. But the results attained to-day by the city force on the street trees are most encouraging, and I think it will result this fall in inciting the citizens to work actively in suppressing the moths on their premises. People are getting better educated in regard to the gypsy moth; and know how to cope with it better than ever before. They are learning the use of creosote and of Tanglefoot. I think the amount of creosote used in Malden last fall was double that used in the previous year.

AUG. 1, 1906.

W. W. FIFIELD, MEDFORD.

I live on Salem Street. Where there were 1,000,000 gypsy moth caterpillars to be seen last year in my neighborhood, there is scarcely one to be found to-day. Two years ago was the worst caterpillar year. The caterpillars then were worse than they ever were in the past, even in the early 90's. The usual scenes of the past—fences, sidewalks, etc., covered with caterpillars—were repeated. I kept them off my trees by dint of hard work, morning, noon and night. I had the egg clusters treated during the leafless season, and banded the trees to keep the moths from getting in them again. When the caterpillars were small, I killed myriads of them on the fences. I have four elms over one hundred years old, in which I take great pride, and I would not lose them for anything. In the last two years, when the caterpillars were so thick, they came from Fulton Street up to my place. They all seemed to be moving in the same direction; it was a systematic movement; they seemed to know that they would find foliage to eat in my elms.

Speaking for the residential parts of Medford generally, great progress against the moths has been made. This improvement has been brought about by the action of the city government in making appropriations. The work has been administered in splendid shape by Supt. John D. Dwyer. There has been an equivalent for all moneys expended. If the city continues the work as it has this year, the moths,

if not exterminated, can at least be gotten into a harmless condition. But there must be continuous, diligent, vigilant endeavor on the part of the city and the Commonwealth.

AUG. 1, 1906.

J. MOTT HALLOWELL, MEDFORD.

Speaking for West Medford, the improvement in regard to both species of moths has been wonderful. The condition of our street trees is infinitely better than a year ago. I think the city officials in charge of the trees should be given great credit for this state of affairs. On Irving Street, where I live, we were in the heart of the trouble last year. The trees were very badly infested. There were literally hundreds of thousands of gypsy moth caterpillars. This year we are almost free from them. I have no doubt that in our handsome shade trees along our streets the gypsy moth pest can be controlled, — it is in fact now controlled. I think the property owners of West Medford generally have cared for their places in compliance with the law. We note a like improvement in the case of the brown-tail moths. The work against the gypsy moths by Gen. S. C. Lawrence has been a godsend to the city of Medford. He should be given great praise for what he has done.

AUG. 1, 1906.

GEORGE S. HATCH, MEDFORD.

The gypsy moth caterpillars have been reduced fully 80 per cent. since last year. Last winter we thoroughly searched our place for egg clusters, which we destroyed. In the spring we sprayed, burlapped and treated with Tanglefoot, and our efforts were ably supplemented by the supervision of the State inspector, who, after the place had been declared cleared by the men whom we hired, pointed out 80 nests which had been missed. This resulted in further treatment of every tree, which led to the discovery and destruction of still other nests. We are much indebted to the State moth office for its co-operation in this matter. Had we depended solely on our own cursory examination and the statements of the workmen whom we had employed, we might be no better off this year than last. Last year we had a great many caterpillars, and it was only by constant attention that we kept a respectable head of foliage on our trees.

Our work this year was supplemented by that of General Lawrence, to whom we owe a debt of gratitude which it will be very difficult to repay. He saved us from invasion by millions of caterpillars. He not only worked on our place, but also did much especially valuable work on a neighboring estate which was owned by a non-resident, who held the certificate, given him by the man whom he had employed, that the place had been cleaned. Conditions on this vacant land were simply appalling. It was a regular jungle. The Lawrence men cut and burned it all over. A gang of 7 men in ten days killed millions of caterpillars.

But even after this there was an enormous quantity, which seemed literally to come out of the ground. This, in my opinion, was the result of the scattering of eggs by improper methods of work. The caterpillars massed themselves in sheets beneath the Tanglefoot bands on the oaks on this land. One night my neighbor, after saturating with kerosene the mass on the trunk, set it on fire, and it flamed up into the branches of the tree. On the side of my estate adjoining this neglected lot I protected my trees with extra heavy bands of Tanglefoot, which resulted in the destruction of additional thousands of caterpillars.

There is, I think, an immense gain apparent everywhere to-day in all the residential sections of Medford. I think our greatest moth-menace to-day is the land owned by the Commonwealth,—the Middlesex Fells reservation.

As to brown-tail moths, for several years my family have been badly poisoned, but this year they have escaped harm.

AUG. 1, 1906.

D. N. HOWARD, MEDFORD.

In comparison with recent years, the gypsy moth caterpillars in the residential parts of Medford have been this year a trifling thing. Although I knew a great deal of work was being done, I have been astonished at the good results attained. I am really surprised that so much has been done. This, I think, is due to the generally aroused public sentiment in regard to the moths, which in its turn has been brought about by the good example set by General Lawrence, and the knowledge that the State and city had combined in a concerted scheme of action to push the work on public trees. I have not the slightest doubt that, as before, when the State work had reduced the gypsy moth to harmlessness in Medford, we can by persistent effort against the moth in all stages of its existence get back to the good conditions which obtained six years ago. But there must be no let-up, no cessation in the work of co-operation.

To contrast the conditions to-day with those of a year ago: people crushed caterpillars as they walked on the sidewalks; these were mostly those of the gypsy moth, but there were brown-tail caterpillars also during their time. As you glanced up the street, you might have thought that a citizen engaged in this work of destruction, as he stepped from one unfortunate worm to another, was playing hop-sotch; this year we have seen very few caterpillars at any time on the sidewalks. Last year I kept a can of kerosene in readiness for the caterpillars on my veranda; this year very few of these have been observed. This improvement in regard to caterpillars is also true of my neighbors' yards. In the residential district of Medford last year there was very much stripping of trees—notably apples and purple beeches—by the gypsy caterpillars, and this included some of my own trees; this year, so far as I have observed, there has been very little stripping.

The falling off in numbers of caterpillars applies both to gypsy and brown-tail moths. I have not observed this year anything like the number of brown-tail moths flying that was observed last year. I have not seen this season any posts plastered with moths, as last summer. Last year and year before last we sold a lot of lotion for brown-tail poisoning, but this summer there has been a very limited demand for it.

AUG. 1, 1906.

CHARLES H. ADAMS, MELROSE.

In Melrose there has been a very great change for the better in the moth situation. We see it in less numbers of caterpillars, good condition of the trees as to foliage, and freedom of the citizens from the brown-tail rash. While there have been cases of non-compliance with the law by property owners who did no work against the moths, I think that the people as a whole have tried to do their share of this suppressive work. The law should provide a heavier penalty for failure of owners to do what is required of them. If there is any danger in the situation to-day, it is that owing to the good work of the city employees people will think that the chief cause for alarm is largely over, and so will cease their own efforts against the moths.

AUG. 1, 1906.

CHARLES J. BARTON, MAYOR, MELROSE.

I am perfectly satisfied with what has been done against the moths in Melrose this year. A great improvement is manifest over last year. Except in the case of people who live on the woodland borders, we have had very little discomfort as compared with previous years. For several years running, previous to this summer, I could scarcely sit on my piazza on account of the caterpillars. This summer I have not seen one caterpillar on my place. I believe that if the moths are fought as hard for a few years longer as they have been in the first year of the State work, they will be brought down to so small a figure that they can be taken care of at a very slight annual expense.

As to the brown-tails, an even greater improvement is noticeable. I have seen very few brown-tail moths flying this year, and have heard of but very few cases of poisoning. My family escaped poisoning this year as we did not last year.

AUG. 1, 1906.

HON. SIDNEY BUTTRICK, MELROSE.

Moth conditions in the residential district of Melrose are much better than last year. I live in the former heart of the infested district, where last year my trees and those of my neighbors were denuded more or less and bore little fruit. This year the trees are in good foliage and have fruit. As I have driven about the residential parts of Melrose I have not seen this summer any perceptible sign of the gypsy moths.

We were badly infested a few years ago, and it was a foregone conclusion that this year the state of affairs in Melrose would have been terrible had it not been for the work of our citizens' committee and the State work as planned by the State superintendent. Our committee was formed early in the spring of 1904, a fund raised, and the moth work systematized by wards. An organizer of the committee, having always maintained my interest in the work and having had good opportunity to observe all over the city, I am, perhaps, as well able as most people to give an opinion on the present status of the moth problem.

AUG. 1, 1906.

REV. THOMAS SIMS, OF THE MELROSE HORTICULTURAL AND IMPROVEMENT SOCIETY, MELROSE.

In comparison with last year at this time, we are very free from the gypsy moth caterpillars in the center of Melrose, and it looks as if we had mastered our problem. While early in the season there was promise of a great many caterpillars, from some cause, whether spraying or something else, their numbers are very greatly diminished. I believe we have made such gain as to give reason for distinct encouragement. For several years past the great bulk of owners and occupiers of property have worked hard to destroy the moths. A great deal of work in all has been done. Two years ago the gypsy caterpillars were most plentiful. We had them in great bunches. On my place, from not more than two dozen trees we took on an average daily for several weeks two quarts of caterpillars. This is a low estimate. Last year they were not in such great numbers as in 1904. The brown-tail caterpillars have been decreasing steadily for three years past.

My society, formerly the Melrose Amateur Gardeners' Society, did much to inform the people in regard to the moths, and it paved the way to the formation of the citizens' committee which did so much to further the moth warfare in Melrose.

AUG. 1, 1906.

CLARENCE FOX, SELECTMAN, SAUGUS.

No comparison is possible between the conditions in the village of East Saugus to-day and those of several years ago. In March, 1905, before the present law was in force, we raised a fund in our village for work against the moths, hired a gang of professional moth men, and gave them the contract to clean the street trees. People joined in the work by caring for the trees in their yards, and the result was that we practically freed the village of the moths. But we should have had to repeat the thing over and over again from year to year, because the pests would have come in on us from outside. The State law, however, went into effect, and the town employees continued our good work in East Saugus, besides working in the residential parts of Saugus generally, so that to-day our village is, to all intents and purposes, absolutely

free of the moths, and a vast improvement appears over most of the town.

Operations against the gypsy moth locally have been carried on with a great deal of intelligence by the authorities. You would be astonished this year at the way citizens also took hold to clean up their places. So far as I have seen, there has been that private co-operation with the State work which the framers of the present law contemplated. If the same spirit is manifested elsewhere as in Saugus, the moth problem is on the way to being solved.

As to the actual visible results of the State's campaign in Saugus, throughout the residential parts of the town you can see to-day no stripping along on the streets. Street trees and trees on private lands bordering on roadsides are in good condition, and this result is just what was planned for. Of course, if you look up back from the roads, you can see abundant signs of the moth's ravages. But the imminent danger of the farther spreading of the moths by vehicles as the result of badly infested roadsides had first to be taken care of, and the problem of the woodlands will come next.

The good condition of our trees on and bordering streets to-day is an object lesson to everybody in town. There was a time when I felt discouraged, and feared that no headway could be made against the moths, but the way the State has taken hold and the results already achieved demonstrate that the pests can be checked. If, after the expenditure of so much money in the town of Saugus, there should still be bad conditions in the residential sections of the town, then there might well be grave doubt if ultimate success against the gypsy moth could be achieved. As to the woodland problem, it is only a question of sufficient work being done, this being made possible by sufficient funds. There is no doubt about this. The State has already demonstrated that the moths can be suppressed along streets and in yards, and if this result can be brought about in the village, the harder task of checking the pests in the woodlands can also eventually be done.

I do not think that the idea of the co-operation of the individual with the town and State, upon which the present law is based, will fail in practice. Once you get the moths so reduced in residential sections that they can be handled at small expense annually, the citizens will not complain of their small tax, and it will be only the smallest-minded man who will grudge the necessary expenditure, even though large, in woodlands elsewhere in his town which protects him from invasion again, while it benefits the owner of the woods. Such a man would lose caste among his fellows.

One more point I wish to make. I had an apple tree and a maple tree which the gypsy moths killed. This was simply because I was unaware of the nature of the pest, and of the best way to fight it. The first I knew of the danger the maple was in was when I heard the cat-

ing of the caterpillars up in the foliage, and then it was too late to save the tree. The reason the moths got such a start of us the last time (I mean since the lamentable stoppage of the State work in 1900) was because of popular ignorance on the subject. Remedy this (and we are doing it every day), and the gypsy moth problem is solved.

AUG. 1, 1906.

HON. SIDNEY A. HILL, STONEHAM.

There has been a wonderful improvement in Stoneham. This relates to both public trees and those in private yards. I think if you ride to-day through the center of the town you will not find half a dozen places where there is any sign of the moths. Mr. Jefts, our local superintendent, is a most competent man, and he has made the State and town appropriations last well. As to complying with the law, people as a general thing have cleaned up their yards and gardens.

In 1904 we had brown-tail moths in great numbers in July. An arc light in front of a store drew so many of them that it was cut off, and gas used instead. My store windows and other windows around the square were plastered with the millers, which flew in squalls after dark. Last summer everybody had the rash. To-day I do not think that over fifty millers can be seen at a time flying around an arc light. I have heard of no case of the rash. We have certainly got the better of the brown-tail moth.

The work of the improvement society in the summer and fall of 1904 has counted for much in bringing about the good results we see in Stoneham to-day. A campaign of education was waged, so that the people became aware of the moth danger. A committee was also chosen to see all property owners, and a fund of about \$1,000 was raised. With this money the trees on our main streets were cleared of the moths, and simultaneously property owners were induced to sign an agreement to take care of their own trees.

AUG. 1, 1906.

J. W. HOLDEN, CHAIRMAN, BOARD OF PUBLIC WORKS, STONEHAM.

In the center of the town of Stoneham where there were last year 100 gypsy moths, there is not to-day more than 1. The brown-tails are still more diminished than the gypsy moths. Previous to this year I was poisoned a good deal by the brown-tails.

The town work against the moths has gone on well, and on the whole property owners have co-operated with the town. While the gypsy moth conditions are improved in the central residential sections, in this neighborhood they are worse than last year. Last year we destroyed many egg clusters on our place, but this summer everything south and west of us to the metropolitan park line was stripped, including with the rest practically all of our trees. We suffered from the neglect of

the park authorities, and of others who did nothing against the gypsy moths. The caterpillars came in on us by thousands—literally in droves—from the park, and now our trees are as bad as ever.

AUG. 1, 1906.

DR. FRANK WOODBURY, WAKEFIELD.

When the State work stopped in 1900, the gypsy moths were so few in Wakefield that practically there were none at all. In 1901 a colony was found near the car barn; in 1902 there were not over three isolated colonies in the town; after that there was a gradual increase, until in 1905 the moths were well scattered over the town, but still in comparatively small numbers except in three or four colonies where there were a good many. To-day we have on an average ten times the number of gypsy moths over the town that we had a year ago. While the work against known colonies of the moths has been very satisfactory, in the localities where there were few previously, there is a very noticeable increase of the insect.

As to the brown-tail moths, we are far ahead of the conditions in the past. In fact, the brown-tail question is hardly a question at all in Wakefield to-day. The brown-tails this summer have hardly been more in evidence than the tent caterpillars. I went down repeatedly to the scrub oaks on the east side of the town, where last year the trees were riddled by the brown-tail caterpillars and where later the trees were full of their nests, and it was hardly possible to find a live caterpillar in the nests. Mr. Whittredge has done splendid work against the brown-tails. A great many adult brown-tail caterpillars have died this year of fungous disease. The flight of millers was very small this summer. Last summer during the miller season the ground beneath an arc light in front of my house would be white with wings of brown-tail moths which the English sparrows had caught on the under side of leaves, where the insects were laying their eggs. The number of cases of poisoning has fallen off very markedly this summer.

I think the disposition on the part of the citizens to do work against both kinds of moths is good.

AUG. 1, 1906.

JOHN L. HARVEY, MAYOR, WALTHAM.

With regard to the brown-tail moths, I am satisfied that we are very much better off than last year.

As to the gypsy moths, we have very thoroughly cared for three or four localities in the residential part of the city where last year there was a bad, though restricted, infestation. Certain oaks in these places were loaded with gypsy moth nests. One of these trees was entirely stripped last year, and another partly so. During the winter the egg clusters in the above-mentioned localities were treated, and this summer there has been no defoliation. Throughout the residential portions of Waltham, in fact, there have been no trees stripped this summer. So

far as the residential district goes, it seems in better shape than last year.

As to the woodlands, defoliation occurred in the Maher woods on Trapelo Road, but thinning out was done there, and the tract is now in good condition. The owner himself thinned out the place in part, and the rest of the necessary work was done by the city. The wooded section comprising the woods of the Rindge farm, Flagg estate and adjoining farms is badly infested, and will require strenuous efforts on the part of the owners to save their trees. The region immediately north of Hardy's Pond is rather badly infested. The farming region in the northeasterly part of the city is generally infested.

I think there has been, on the whole, compliance with the law by citizens. We shall have to do more work against the gypsy moth next year than this.

AUG. 1, 1906.

OBSTACLES TO THE WORK.

It is not surprising that in any operations involving to a certain extent — as does this work — the exercise of the police powers, there should develop a certain amount of friction, harsh criticism or open opposition. There have been many minor complaints on the part of property owners concerning the special assessment levied upon them by cities and towns for failure to comply with the law. In the case of certain municipalities there has developed considerable opposition to providing sufficient funds for the prosecution of the work, and delay or refusal to place competent men in charge of the same. There has also been in some cases unwise expenditure for inefficient labor, or for purchase of tools and supplies at excessive prices. In the matter of unwise or improper expenditures the superintendent has declined to approve the pay rolls or schedules in which they occurred, but this is only a minor trouble, relatively speaking. The two great obstacles to the success of the present State work are the failure of towns and cities to provide the necessary funds, and the appointment of inefficient local superintendents. If it were possible to draw a cordon around those municipalities which seem indifferent to the increase of the moth pest, and leave them to their own destruction, public sentiment in favor of liberal appropriations for moth work in such communities would soon assert itself. But unfortunately the moths do not recognize town bounds; and where a city or town is allowed to remain badly infested, the insects soon

spread to surrounding municipalities where good work is being done. A recommendation of how best to deal with this situation is made in another place.

As far as individual property owners are concerned, it seems a peculiar and very discreditable thing that certain citizens have complained bitterly against paying even the nominal tax, which represents the cost of clearing their infested estates. We submit that this procedure on the part of property owners is not in the line of self-interest, nor is it good citizenship. The necessity of the work has been too thoroughly presented to the public to need further comment. It is for the benefit of all that it be thoroughly done. It is of no avail that one man clean his place, if the contiguous estate be left to become a breeding spot to reinfest adjoining estates. The preservation of our trees is a matter of public welfare. They are, in a measure, the property of the public, and contribute to its health and comfort. The selfishness of the individual should not be allowed to stand in the way of preserving the trees for the good of all.

FUTURE WORK.

The work for 1907 will include holding the ground we have gained along the streets and in the residential districts generally, with a continuance of the policy of clearing protective belts along the main highways, so far as funds will permit. If possible, the principal woodland colonies will also be isolated by means of protective belts. During the remainder of the present winter the work of clearing infested private estates and street trees will be vigorously carried on, and a general enforcement of the provisions of the law insisted upon. We shall continue the policy of inspecting or having inspected the work done by contractors and by citizens, to the end that no serious infestations may escape proper treatment.

The season of 1907 will see a more general use of spraying outfits early in the caterpillar period, — a method which in favorable weather cannot fail to give the best of results.

There should be next season a general use of sticky bands on trees in infested woodlands, and where it has been impossible to clear the ground, rocks and ledges of gypsy moth nests. The general use of the burlap on street, lawn and orchard trees is



LEPIDOPTERA. L. B. L. 1850.

PLATE 10. 1850.

THE L. B. L. 1850. 1850.

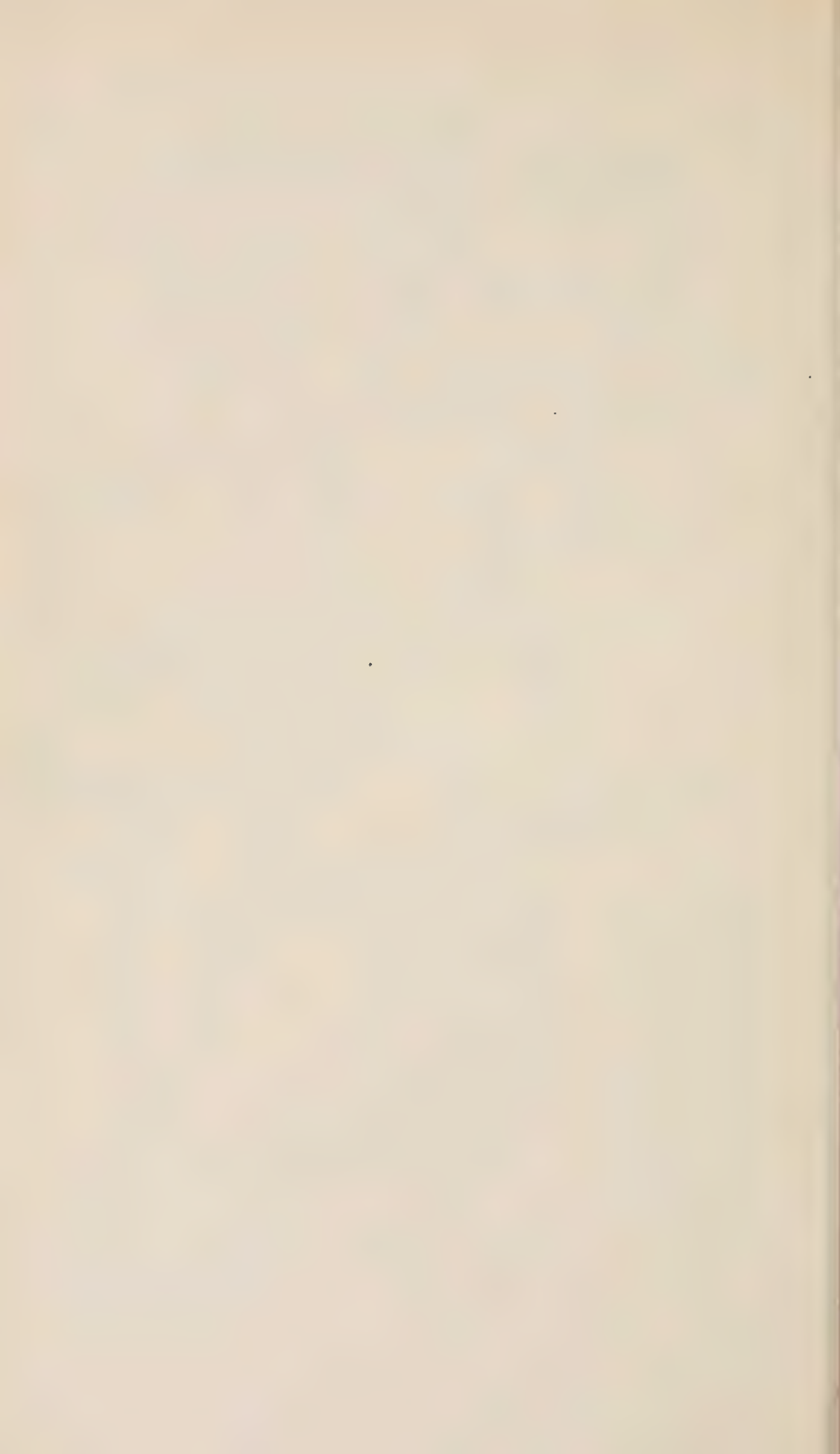
EXPLANATION OF PLATE.

Schematic plate, showing all stages of brown-tail moth: —

1. — Egg cluster.
2. — Newly emerged caterpillars.
3. — Partly grown caterpillars.
4. — Pupæ, slightly reduced.
5. — Male moth.
6. — Female moth.
7. — Winter web.

(Used by courtesy of Dr. E. P. Felt, State Entomologist, New York.)





also most heartily recommended. Woodland colonies where thinning operations have been carried on should be burned over with a light fire about May 10, or as soon as the eggs have hatched.

In the late summer there should be a general crushing of pupæ and creosoting of female moths before they have opportunity to lay their eggs. Following this, the work of clearing the trees of gypsy moth nests from the ground upward for a distance of 6 or 8 feet, should be prosecuted. As soon as the leaves fall, the usual fall operations of creosoting gypsy moth egg clusters and destroying brown-tail moth nests should begin. In the fall months also the usual work of cutting roadside brush and worthless trees will be carried on.

One point which cannot be overlooked by the local moth forces without detriment to the work is the necessity of mowing the young brush which springs up in the early spring months along roadsides and in woodlands. If this brush can be mowed and burned once or twice during the season, important breeding and hiding places of the gypsy moth will be eliminated.

In the field operations it has of course been necessary to organize and educate local forces; and with the experience gained in 1906 there will be greater confidence in the methods outlined by the central office, and a more general adoption of those found to be effective.

REPORT OF THE CONSULTING ENTOMOLOGIST.

As in 1905, the superintendent has relied for expert advice and counsel upon the consulting entomologist, Prof. C. H. Fernald, whose assistance at all times has been freely given, and has been of the utmost value. No entomologist in the country is more familiar with the gypsy and brown-tail moths than Professor Fernald, while, from his long and successful experience in economic work, his counsel has been of particular value. His report is presented herewith:—

A. H. KIRKLAND, Esq., *Superintendent for Suppressing the Gypsy and Brown-tail Moths, Boston, Mass.*

DEAR SIR:— Since my report of last year I have made frequent inspections of the territory infested by the gypsy moth, and learn that this insect has been found in some 15 towns outside of and adjacent to

those reported as being infested last year. These new colonies are of course comparatively small at the present time. A slight infestation occurs also in many of the forests of Plymouth County, as well as in the forests north and west of Boston. These slight infestations form so many centers from which the insect will spread rapidly, and in a surprisingly short time thoroughly infest the entire region, with the result that the forest lands will be so generally and thoroughly infested that the pine timber of the Plymouth County region may be destroyed, as well as the other kinds of valuable wood in this territory.

Throughout the infested region there are many old orchards containing more or less hollow trees, within which may be concealed numerous egg masses of the gypsy moth which are quite sure to be overlooked; and, as a result, the cost of clearing these orchards will amount in a few years to far more than they are worth. It is therefore much the wiser policy, even for the owner himself, to remove all hollow trees from an orchard, and then young trees can be set out to replace them. These young trees, if they become infested, can be much more easily and cheaply freed from insect pests than the older ones.

In most of the towns and cities those in charge of the work have obtained excellent results; but in a few cases the persons appointed by the authorities to carry on this work have no special fitness for it, either by nature or by training, and, as a result, there has been much waste of time and money. The taxpayers of these towns and cities, who furnish a part of the money, and the taxpayers of the Commonwealth of Massachusetts, who furnish the rest of it, have a right to demand that there shall be a judicious expenditure of the funds. In a few places the authorities themselves have been remiss in their duties under the law, and either have not furnished their proper appropriations, or have failed to make them at the time when the most effective work could be done for the suppression of the gypsy moth. These things are very embarrassing, not only to the superintendent of the work, but to all interested in its success, and to manage such cases judiciously requires the patience of Job and the wisdom of Solomon.

In some places, as at Medford, Saugus, Canton, Milton, Framingham and Natick, public-spirited citizens with noble and generous impulses have undertaken the oversight of this work, or have made large personal contributions to it, thus relieving the taxpayers of the town of more or less of the burden that would otherwise have fallen upon them. Let us hope that such instances are fully appreciated by the residents of the towns where they occur.

The expense of properly clearing an infested orchard, ornamental trees and shrubs, or a piece of forest land of the gypsy moth is far greater than one who has had no experience with this insect would imagine. The cost of clearing forests alone, as shown in the report of last year, page 106, is "not far from \$50 per acre, and to this must be added the expense of putting burlaps on all the remaining trees the

following season, and killing the caterpillars under them." We may therefore fairly say that the entire cost will be more than \$60 per acre, and this would have to be repeated whenever the forest in question should become reinfested. It may be claimed that the forest lands of the State are not worth enough to warrant such an expenditure on them. The average value of the woodland in the entire State, as given in the last State census, is \$16.38 per acre, while in the territory already infested its average value is \$27.08 per acre, which is less than half the cost of a single clearing of the land of the gypsy moth, and therefore the claim might seem reasonable.

What, therefore, is the wisest, best and most economical course to be pursued by the Legislature? Shall the work be entirely abandoned by the State, and the suppression carried on entirely by the land owners at their own expense? It has been shown repeatedly that the owners have never been able to control this insect except in a very few cases, like those of Gen. S. C. Lawrence of Medford and a few other gentlemen who have ample means. Neither poor men nor men of ordinary means can be expected or required to go on year after year destroying these moths on their premises, at an expense greater than the value of their property. Should the moth be allowed to increase and spread, such a course would end in a series of abandoned farms from one end of the Commonwealth to the other, and in an enormous loss of wealth to the State. Such a course is so extremely and plainly unwise as to need no further discussion.

The alternative course for the Legislature is to make such appropriations as shall, together with those made by Congress, enable those in charge of the work of suppression to prevent the further spread of this pest, and gradually reduce the infested areas. This course will demand large appropriations, the size of which can only be determined by those who have charge of the work and are conversant with the localities and extent of the infestations in each town, and who from long experience are able to judge of the cost of suppressing the insects under such conditions. These appropriations must necessarily be large, for every infested place, however small, should be carefully attended to, even in the forests. If this forest work is neglected by reason of insufficient appropriations, the moths in slightly infested places, like those in Plymouth County, will spread rapidly, and in consequence all the valuable timber will be absolutely destroyed by the stripping of the leaves,—the pine forests in a single year.

Such appropriations as are necessary at the present time and under existing circumstances are in no way to be compared with the cost of clearing the moths from the trees when once they have become infested; and to illustrate this point as clearly as possible we quote from the report of last year, page 106: "The taxable property of this State, as given in the last Manual of the General Court of Massachusetts, page 235, is \$3,420,197,428. If this amount of property be assessed

for \$200,000, the tax on \$1 would be a little less than one-seventeenth of a mill ($\$0.000\frac{1}{17}$); and a man owning taxable property to the value of \$5,000 or a farm of that value would have to pay a tax of \$0.294, which might be regarded as a premium paid to the State to insure him against the ravages of the gypsy moth. This is far less than one would have to pay for clearing the moths from a single apple tree. If this tax should be continued for forty years, as long as a man would be likely to have charge of a farm, his premiums for that time would amount in all to \$11.76, — a much smaller sum than would be required to clear this pest from a small orchard in a single year."

The property owners in central and western Massachusetts — the part of the State not yet infested with the gypsy moth, — have such a fear of this pest and desire so strongly to be protected from it, that, as far as I have been able to learn, they are entirely ready to pay their share of such appropriations as are necessary to prevent the insect from spreading beyond its present limits and eventually invading their lands.

It is undoubtedly generally understood throughout the State that the Legislature of 1899-1900, which closed up the work on the gypsy moth when the extermination of the pest was almost completed, made a most serious mistake. When any Legislature by its action or lack of action on a case shall, through inadvertence or otherwise, bring about a result so disastrous as this, it would seem to thoughtful taxpayers to be the duty of following Legislatures to do everything possible to remedy the disastrous results of acts of that previous Legislature.

Respectfully submitted,

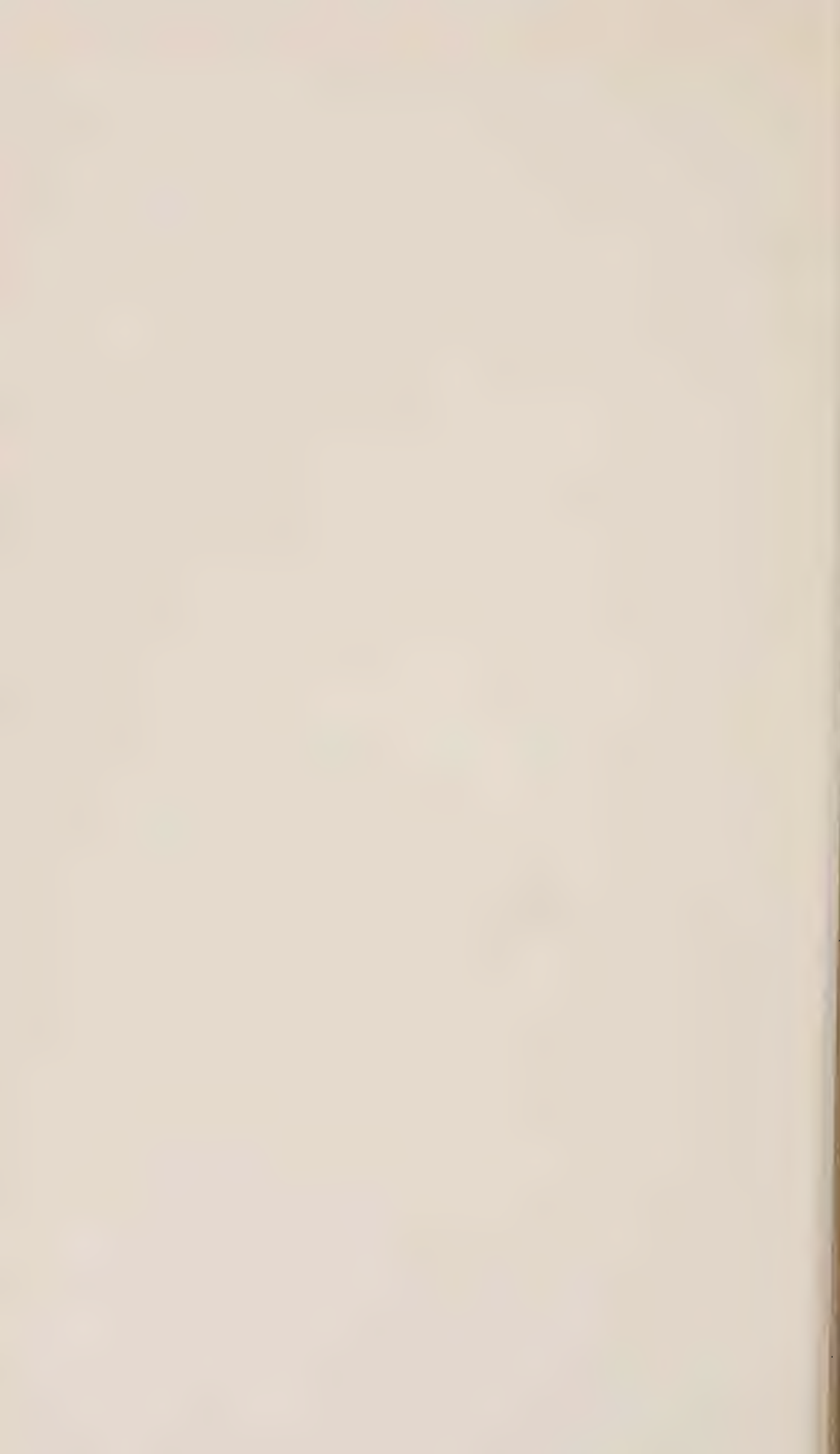
CHARLES H. FERNALD.

IMPORTING PARASITES.

The effort to import parasites has been carried on as vigorously as seemed consistent with proper care and scientific accuracy. We are glad to record again our obligation to Dr. L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture, Washington, D. C., who has kept constantly in touch with this part of our work, and has directed all the necessary operations. Dr. Howard went abroad again last spring to perfect the organization of the corps of European collectors; and as a result of his efforts we now have on our staff nearly every economic entomologist of note in the moth-infested district of Europe. We also had the benefit last summer of the services of one of Dr. Howard's assistants, Mr. E. S. G. Titus, who, with Mr. F. H. Mosher of this office, had direct charge of the caring for the imported material and the breeding and disseminating of the parasites. To assist them during the height of the breeding season several students from various



Box used in breeding parasites. The parasites, emerging from infested material within the box, and attracted by light, enter the glass tubes in the side.



agricultural and other colleges were employed, but the main operations have been cared for by Messrs. Titus and Mosher. The conscientious efforts of these men are worthy of all praise, particularly their courage and faithfulness in continuing day after day the work of caring for over 100,000 brown-tail moth webs, with the consequent bodily suffering caused by the highly poisonous insects. Dr. Howard's report is given below:—

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY, WASHINGTON, D. C., Nov. 24, 1906.

Mr. A. H. KIRKLAND, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

SIR:—I have the honor to submit a brief report of my efforts during the period since I submitted my last report to you, on Dec. 30, 1905, to import the foreign parasites of the gypsy and brown-tail moths into Massachusetts.

Respectfully yours,

L. O. HOWARD,
Chief of Bureau.

I stated in my last report to you that, on the strength of information received from Professor Jablonowski of Budapest, concerning the occurrence of minute parasites in winter nests of the brown-tail moth, I had secured the sending over to Massachusetts of a number of nests of the brown-tail moth from different parts of Europe, in the hope that there might be bred from them near Boston in the spring of 1906 an abundant supply of these parasites. As you are aware, and as you will probably state in your individual report to the Senate and the House of Representatives of the Commonwealth of Massachusetts, more than 117,000 winter nests of the brown-tail moth were sent to you before spring by the paid agents I had engaged in Europe, and by voluntary correspondents with whom I had made arrangements. It is worthy of note that a large number of the nests (several thousands) were sent in through the efforts of Mr. René Oberthür of Rennes, France, whose interest became engaged in the work from the published account of an address which I delivered before the Entomological Society of France in June, 1905. These nests were cared for, as you are well aware, in the parasite laboratory at North Saugus, by one of your assistants, Mr. Mosher.

In March, 1906, I detailed one of my expert assistants, Mr. E. S. G. Titus, a man who had been trained in the best methods of breeding insects and in the care of parasites, and who possesses an expert knowledge of the different groups of parasitic Hymenoptera, to accompany me to Boston and to examine into the condition of the hibernating nests, which, by the way, had purposely been selected from every part of

Europe west of Russia, so as to cover all possible climatic variations within that geographic range. Mr. Titus and I were pleased to find, on opening representative nests from the different regions, that all contained larval parasites busily engaged in feeding upon the young hibernating brown-tail moth larvæ. The season at that time was not sufficiently far advanced for the work to demand the entire attention of Mr. Titus. He was therefore instructed to return to Washington, and to take up his headquarters at the North Saugus laboratory as soon as the parasites should begin to emerge and the Massachusetts brown-tail moth larvæ should begin to issue from their winter nests and to attack budding foliage. Mr. Titus was instructed to remain at the laboratory and to take entire charge of all the parasitic material, carefully separating all secondary parasites from the true primary parasites, and destroying the former; also to take every precaution against the issuance of other European insects which the nests might accidentally contain. Further, he was instructed to colonize, with your advice and assistance, all issuing parasites in such locations as should seem to offer the best chances for the establishment of the species on American soil.

Having made these arrangements, I sailed from New York on March 17 for Europe, returning to America May 17, the travelling expenses being paid by the United States Department of Agriculture. In the course of this journey I interviewed correspondents and agents in Paris, Rennes, Montpellier, Marseilles and Hyères, France; Naples, Florence and Milan, Italy; Vienna, Austria; Budapest, Hungary; Dresden and Tharandt, Germany; and Zurich, Switzerland; at the same time, in the latter part of the journey, making efforts to learn of localities where either the gypsy moth or the brown-tail moth might reasonably be expected to be abundant during the summer of 1906. Wherever such localities were heard of, the information was given to my agents. All of the agents and correspondents were given full instructions regarding the work for the summer of 1906 and the winter of 1906-07. The experience of 1905, with regard to the best methods of packing and shipment and the best kinds of boxes used, was related to all; and these points were fully discussed, with the result that the material received during the summer of 1906 was not only greater in quantity but better in condition than that received during the previous summer. All of the persons mentioned especially in my last report to you were visited, and in addition to these I may particularly mention, among the others whose services were enlisted, Prof. C. Houlbert of Rennes, Professor Valéry Mayet of Montpellier, Dr. P. Siepi of Marseilles and Mr. Harold Powell of Hyères. I also had the good fortune to find in Vienna Dr. Gustav Mayr, whom I had missed in my 1905 trip. Dr. Mayr is the European authority on several of the groups of parasites most intimately connected with this work, and I had a long consultation with him concerning the systematic position of some of the forms already imported, and concerning the practical possibilities of the whole series

of micro-Hymenoptera. Through Dr. Mayr I learned of the probable importance of certain egg parasites of the brown-tail moth which he himself had reared in Europe and had described. As the result of this information, egg masses of the brown-tail moth were brought over to Massachusetts in midsummer, and parasites were reared from them by Mr. Titus and were observed to lay their eggs.

Mr. Titus bred not only the species referred to by Dr. Mayr, namely, *Telenomus phalænorum*, which came from eggs forwarded by Miss Rühl and collected in Croatia, but he also reared an apparently undescribed parasite of the subfamily Trichogramminæ, from egg masses received from Wurtemberg, Dalmatia, and Rhenish Prussia. Both of these species also were observed to lay their eggs in the eggs of the brown-tail moth at North Saugus.

On the whole, the importations of the spring and the summer were very successful as far as the issuing upon American soil of a number of species of important European parasites is concerned. More than fifteen species were reared. Further than this, complete generations of several of the parasites were followed through, and the very important point was determined that the principal parasites reared from the brown-tail moth nests in the early summer would lay their eggs in the larger American brown-tail moth larvæ during the summer, and also in the chrysalides of the brown-tail moth and in the larvæ of the gypsy moth and the chrysalides of the same species as well; thus providing for the practical carrying through the entire season of parasites found in the wintering nests of the brown-tail moth in Europe, rendering it possible for the late issuing individuals to attack recently hatched brown-tail moth larvæ in August and September, and thus to be carried through the winter in the American wintering webs.

Of the parasites thus reared, I am inclined to base my hopes of success on the species of *Pteromalus* which we have called *P. processioneæ* Ratz., on account of the fact that it is such an abundant European parasite, stinging a number of species of hairy caterpillars, and on account of the further fact that it was bred at North Saugus in such great numbers, — it was by far the most abundant species reared from the imported nests. I am also inclined to expect good results from the egg parasites mentioned, although it is too early to predict with any certainty. Among the parasites reared from larvæ received during the summer, aside from the *Tachina* flies, which were the most numerous and which may or may not prove successful, I have the greatest hopes of *Pimpla examinitor*. Although only 150 or 200 specimens of this species were reared, it is an important parasite, and we have as a basis for hope the fact that a congeneric parasite, *P. inquisitor*, in this country has been found absolutely to wipe out an extensive invasion of the white-marked tussock moth in the city of Washington.

In my last report to you I referred to the fact that we had been unsuccessful in our efforts to import living specimens of the predatory

beetles, *Calosoma sycophanta* and *Calosoma inquisitor*. During the past season, however, we have been very successful with these species, and 690 of the former and 172 of the latter were received at the laboratory alive and in good condition. Nearly 500 of these were liberated, and they were found breeding in the open. Larvæ were found at different times, and in the early autumn adults of a second generation were found. Should they be able to pass the winter,—and there seems no reason to doubt it,—these important species will have been established in Massachusetts.

There is another important parasite, of the genus *Apanteles*, which we have not as yet been able to rear in numbers in Massachusetts. A few specimens have emerged and have been liberated; but from my observations in June and July, 1905, in Austria, I am inclined to think that this species, or one closely allied to it, is a very important factor in the restriction of the breeding of the gypsy moth. The larvæ imported, however, have been sent, up to the present time, too late, and it is my opinion that this parasite destroys the larvæ mainly during their early stages. Every effort will be made during the coming season, therefore, to import young larvæ of the gypsy moth, especially from Austria and Hungary, with the reasonable certainty that a certain proportion of them will be parasitized by this *Apanteles*.

The well-known occurrence at intervals in large numbers of the gypsy moth in parts of Russia, and especially in South Russia, renders it desirable that search should be made in those regions for parasites. The fact, however, that I had previously been unable to secure answers to letters addressed to correspondents in Russia, and the unsettled conditions of affairs in that country, have deterred me on the two previous trips from visiting the southern provinces. But I have recently received a letter from Prof. J. Portchinsky, of the Ministry of Agriculture at St. Petersburg, informing me that in the southern part of Russia both gypsy moth and brown-tail moth will be found in sufficiently great numbers to enable the collection of parasites, and commending me to certain officials, trained entomologists, in Simferopol, Kischinew and Kiew. He has apprised these officials of the intended visit, and, with your consent, I hope the coming spring and early summer to see what can be done with parasites from South Russia.

In the preceding paragraphs I have pointed out, at your request, some species from which it seems that we can expect the best results. As to the actual conditions which may be brought about by these parasites, it must be repeated that no positive predictions can be made. There seems a perfectly reasonable hope that through them relief will be gained in time. As to the period which must elapse before relief comes, however, no one can give an accurate estimate. Some one or more of the parasites may increase so rapidly that the effect of their work will be noticed in two years; their multiplication, however, may be delayed by unforeseen conditions, so that a number of years may



Out-door cages, covered with cloth and enclosing infested trees, used in breeding parasites.

elapse before they are able to produce an appreciable effect. In these experiments in the international transportation of beneficial insects, experience has shown that even after a long lapse of time species supposed to have died out will suddenly become noticeable, and will do good work.

A marked instance of this character was brought to my attention last month, while on an official trip in southern California. In 1889 Albert Keobeles was sent to Australia by the United States Department of Agriculture to collect and import the natural enemies of the white or fluted scale (*Icerya purchasi*). The parasite of which we had definite knowledge through correspondence with an Australian entomologist, the late Frazier S. Crawford, was a minute fly known as *Lestophonus iceryæ* Will. Mr. Keobeles succeeded in securing this parasite and in sending it to California, and he also secured the now famous *Vedalia* (*Novius*) *cardinalis*, a ladybird beetle which multiplied enormously and destroyed the scale insect within a year after its arrival in California. The *Lestophonus*, however, apparently died out, and nothing was heard of it or seen of it, apparently, so far as the published records go, from 1890 until the present year. It now appears to have multiplied extensively, and to be abundant in southern California. A second instance of the same sort was the original importation by the writer of *Scutellista cyanea* from Italy into the United States, and its colonization upon the wax scale at Baton Rouge, La. This importation occurred in the year 1895. This introduction was apparently unsuccessful. Yet, after a lapse of eleven years, I learned only last month that the *Scutellista* has apparently succeeded in establishing itself in Louisiana, and it is there an effective enemy of the wax scale.

It seems, therefore, improbable that the effort now being made to establish the European insect enemies of the gypsy and brown-tail moth in New England should prove a failure; and in my opinion there is every reason to think, judging from what has already been accomplished, that the prospects at the present time are very good. Surely the large scale on which the importations are being made is a decided innovation in this kind of work, and should bring nearer the period of relief.

In the last report of the superintendent there was given in some detail the records of each sending of parasitic material. The number of shipments in 1906 was so large, however, as to almost prohibit the publishing of these detailed records, which are on file at the Bureau of Entomology, Washington, D. C., and the following summary, from Mr. Titus's notes, will suffice:—

We received all told 117,257 brown-tail moth webs collected from all parts of Europe, a large percentage of the webs containing parasites

of several species. These webs were placed in tight breeding boxes, fitted with glass tubes, and early in the spring began to yield parasites. The issuing of the parasites continued over a period of several weeks, and all told 64,000 primary parasites were so obtained, of which five plantings of 10,000 parasites each, or 50,000 all told, were made in the field. We also imported 37,729 gypsy moth caterpillars and pupæ from which 1,538 primary parasites were obtained. From 36,191 imported brown-tail moth caterpillars and pupæ 1,104 parasites were obtained. Of the primary parasites of these two species of caterpillars, in round numbers 2,000 Tachinid flies were obtained and liberated in the field in 21 different localities. Of the two species of predaceous beetles, 690 living *Calosoma sycophanta* were received, of which 360 were liberated in 7 colonies in the field. Of the smaller species, *Calosoma inquisitor*, 172 were received, of which 110 were liberated in 3 colonies.

In all this work check experiments were carried on both in jars and cages in the laboratory, where the insects were studied at close range, and also in control cages in the field. These cages were made by throwing a light scantling frame over infested trees, covering the frame tightly with cheese cloth and roofing it with heavy duck. All cages used in the experiments both in the laboratory and out of doors were very carefully prepared by Mr. H. R. Gooch, an inspector in the employ of the central office. By means of the field cages we were able to quite closely follow the breeding habits of the insects, and to determine that certain of the most common small hymenopterous parasites, while breeding principally upon the brown-tail moth, also attacked the gypsy moth. We are engaged at the present writing in collecting in the field in places where these small parasites were liberated a large number of brown-tail moth webs, to determine if the parasites are hibernating, as is their custom in Europe. The predaceous beetles were liberated in places where, by reason of thinning operations or brush fires in recent years, there was but little danger of further woodland fires, and we have reason to believe that these insects have now become established with us. All plantings of parasites or predaceous insects were made in important woodland colonies of the moths,—colonies so remote from roads as to make it practically certain that their present condition will not be disturbed for some years.

While no one with less than omniscience can tell what the outcome of our labors along these lines may be, the conviction grows upon me that we are on the right track, that we are doing this work in the right way, and that in the end we shall receive a notable amount of help from these importations. We can now say that to date the parasites have bred here on American gypsy and brown-tail moths in a perfectly normal manner, and are doubtless hibernating in the same way as in Europe. How well they will stand our New England winters, next season alone can show; but there seems to be no good reason to doubt the ultimate success of this experiment, so far as establishing the in-

sects is concerned. The important consideration for the taxpayer is, whether these parasites, even if imported in large quantities, will ultimately prove of material help in suppressing the moths; and it should be borne in mind that this experiment is one wholly without precedent in the annals of applied entomology. There never has been in the history of the world an effort to import on a large scale the parasites of any leaf-eating caterpillar. It therefore follows that, in the first experiment of the kind ever made, every step must be proved before those in charge can be positive of the results. From the present hopeful outlook, however, it seems most desirable that this work should be vigorously continued during the next few years, and arrangements are already completed for the importation and breeding of a much larger number of parasites than heretofore during the coming summer.

This experiment costs but little as compared with the remarkably large sums of money spent in fighting the moths in field operations, and it is to be hoped that sufficient provision may be made for carrying on the work at least for three years more.

FUNGUS DISEASE OF THE BROWN-TAIL MOTH.

On page 127 of the last annual report of the superintendent, attention was called to an interesting fungous disease of the brown-tail moth caterpillars, which in certain localities was very effective in destroying the insects in wholesale numbers. Its effect was very noticeable on the large caterpillars. An investigation of this epidemic by Dr. George E. Stone, botanist, Massachusetts Agricultural College, showed that the active organism was *Empusa aulica*, Reichardt, a common parasite, according to Thaxter, of caterpillars and grasshoppers. It is also mentioned by Grevillius as being common in Europe among brown-tail moth caterpillars, and often to such an extent as to serve as a marked check on their outbreaks.

Following the occurrences of this disease early in the season of 1905, it became evident on the appearance of the small brown-tail caterpillars in the fall that the fungus was widespread throughout the district, and was working with even greater force on the young of the species than it had on the larger ones earlier in the year. By the time the leaves began to fall and the feeding season of the caterpillars was finished, there came in from the entire infested district reports showing that remarkably large numbers of the small caterpillars had died on the outside of the winter webs, as a result of the dis-

case. These reports were usually accompanied by specimens. Often an entire web instead of being white would appear almost brown from its coating of tiny dead caterpillars. Webs of this sort whose contents were carefully counted under the hand lens showed that from 5 to 89 per cent. of the caterpillars had been killed by the disease. At the same time it was not felt that it would be safe to neglect winter work against the webs because of this unexpected help from natural causes, — a conclusion which was amply justified by the results of last summer's work. During the caterpillar season of 1906 an examination of infested white oak woodlands where the webs were abundant and where no work had been done against the moth demonstrated conclusively that the fungus had been an important factor in checking the increase of the pest. But, on the other hand, in places where the disease was present and where from circumstances beyond our control no winter work was done, as in certain sections of Boston and Lowell, a sufficient number of brown-tail moth caterpillars emerged in the spring of 1906 to cause severe annoyance and suffering, particularly in thickly settled residential districts.

It was thought at first that the artificial propagation and dissemination of the fungous disease throughout the infested district might be a feasible and desirable undertaking; but our examination in the spring showed that nature had already done this work much better than man could possibly do, and that diseased caterpillars were everywhere abundant in varying numbers.

Could we feel assured that conditions would favor the occurrence of the disease annually over the entire district, the problem of combating the brown-tail moth would be much simplified. Unfortunately, the history of all contagious diseases of insects, whether bacterial or fungous, shows that their abundance or scarcity is almost wholly dependent upon climatic conditions, usually being favored by warm, damp weather. This has been repeatedly demonstrated with the infectious disease of the Rocky Mountain locust in the west, the grasshopper disease in South Africa and the well-known disease of the chinch bug, which in certain years is of much benefit in western corn and grain fields where the insect is over-abundant. In

other words, the history of such diseases shows that, to be effective, they must be favored by climatic conditions; and that man can do but little in artificially spreading them, unless such favoring conditions prevail.

It should be stated that the fungous disease was very effective against the larger caterpillars during the summer of 1906, killing them by thousands; and that it was still present on the winter webs in the fall, although not so conspicuous as in the fall of 1905. It is also desirable to mention that there is but little if any ground for the popular belief, exploited in the newspapers in the winter of 1905-06, that the presence of dead caterpillars on the outside of the webs is caused by the emerging of the insects during mild weather and their subsequent death by freezing. The death of the caterpillars in practically every case was effected by the disease.

While this disease has been of great help in reducing the numbers of the brown-tail moth, it has given rise to certain unexpected complications in connection with establishing the imported parasites of this insect. At least two important European parasites, which we have introduced, winter in the webs of the moth. In the colonies where these parasites have been liberated by thousands, the disease has been so prevalent as to reduce greatly the number of winter webs, and the consequent opportunities for the successful hibernation of the parasites.

NATIONAL AID.

On Dec. 4, 1905, the Hon. Ernest W. Roberts, representative from the Seventh Massachusetts District, introduced in the national House of Representatives two bills, numbered respectively 285 and 286, the one carrying an appropriation of \$250,000, to be expended under the direction of the Secretary of Agriculture for the purpose of exterminating or controlling the gypsy moth and brown-tail moth; the other carrying an appropriation of \$15,000, to be expended under the direction of the Secretary of Agriculture for the purpose of investigating and importing natural enemies of the moths from Europe and Asia.

By direction of His Excellency the Governor the claims of Massachusetts for national aid in controlling the moth pests

were presented at a hearing before the House committee on agriculture, Washington, D. C., on Feb. 13, 1906, by Prof. C. H. Fernald, Gen. F. H. Appleton, W. H. Bowker, Esq., and State Superintendent Kirkland. Also present and taking an active part in the hearing, which was conducted by Mr. Roberts, were the Hon. Frederick H. Gillett, Hon. Butler Ames, Hon. S. W. McCall, Hon. John W. Weeks, Hon. W. S. Greene, all of Massachusetts, and Director H. J. Wheeler, Rhode Island Experiment Station, and Prof. E. F. Hitchings, State Entomologist of Maine. The damage caused by the moth pests was fully pointed out, and an account given of the work against the insects as conducted in Massachusetts and Maine. The rapidly increasing spread of the gypsy moth was described, and the claim made that, as Massachusetts had spent so liberally of her funds in protecting not only herself but the entire country from the inroads of the insect, it would be but a simple act of justice for the national government to render its share of financial assistance in controlling the pest. The danger from the moth had now become an interstate affair, and, unless systematic work could be done in controlling the insect wherever it occurred, the success of the work in any particular State might be imperilled by the neglect of neighboring States. It was argued also that it was an entirely proper function of the national government to aid at least in keeping the highways, railroads and car lines free from the pest, thereby preventing its farther spread. If this important part of the work should be done by the national government, the infested States would do their part in suppressing the insect in woodlands and residential districts.

Largely as a result of the efforts of the Senators and Representatives of this State, an appropriation of \$82,500 was passed by Congress, to be used in preventing the spread of the gypsy and brown-tail moths in New England.

The national work was promptly organized by Dr. L. O. Howard, Chief of the United States Bureau of Entomology. The State superintendent released, to take charge of the work, his assistant, Mr. Dexter M. Rogers, who began and has prosecuted the field operations with great vigor and efficiency. It is but just to say at this time that, among those most fa-

miliar with the many details involved in combating the moths, the selection by Dr. Howard of Mr. Rogers as field agent has met with general approval, and has been amply justified by the quality of work accomplished under his immediate direction. Since the federal effort has been practically confined to preventing the spread of the gypsy moth, it seemed best that the first step should be to clear, as far as possible, the pest from the main highways of the infested district. To this end protective belts, 100 feet wide, have been thinned of trees on some 25 or 30 miles of roads and streets in all badly infested sections in the central district.

The spreading of the gypsy moth does not take place, as is popularly believed, from the border of the moth-afflicted region, but from the badly infested central towns. In such towns it has often been impossible in May or June to drive for even half a mile without acquiring as accidental passengers hundreds of the tiny caterpillars which spin down from overhanging trees.

The superintendent is of the opinion that the work now being done under Mr. Rogers's direction, if properly followed up next season by spraying and banding, will be the most important single factor involved in preventing further extension of the infested district. This work, so ably carried on, has been of greatest possible assistance to this State, and it is hoped that further appropriations will permit of its continuance. There has been at all times a complete harmony of interests between those in charge of the national work and the state superintendent, and from this co-operative work most satisfactory results must inevitably follow.

WORK OF STATE BOARDS.

As in 1905, the State boards which hold lands in the infested district have heartily co-operated in our efforts to suppress the moths. In some cases, from their ability to control the class of labor engaged in the work, their efforts have been more effective and economical than the operations of certain of the towns. Of particular note is the work done by the Metropolitan Park Commission, Metropolitan Water and Sewerage Board and the Massachusetts Highway Commission. Very

effective work has also been done by the authorities in charge of various insane asylums and other public institutions in the infested district. All these boards have co-operated fully with this office, and in turn we have given them such assistance in the way of advice and inspection as lies within our power under the terms of the act. Thus, we were enabled to inspect and pass upon the winter work done by contractors engaged by the Metropolitan Park Commission, and to plan and follow quite closely the work of the Massachusetts Highway Commission. A summary of these operations is given in the following correspondence:—

METROPOLITAN PARK COMMISSION, BOSTON, Dec. 4, 1906.

Prof. A. H. KIRKLAND, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

DEAR SIR:—The Metropolitan Park Commission presents herewith a statement of the work of the past year against gypsy and brown-tail moths in the metropolitan park reservations and parkways. Last year every reservation and parkway was in some degree infested, or surrounded by infested territory; and in many cases the infestation of the surrounding territory was a special menace because it was largely in woodland which for one reason or another was unlikely to be thoroughly cared for. Middlesex Fells was most seriously infested; the Blue Hills was the least infested, but was showing infestation which caused great alarm and required immediate work of repression. Larger appropriations were made by the Legislature of 1906, and very gratifying results have followed what is believed to have been an efficient and economical use of the funds thus provided.

Natural causes destroyed the brown-tail moths to such an extent that little work against them was required; the work was therefore chiefly against the gypsy moth. In all but the Blue Hills this work was done by the employees of the commission. In the Blue Hills, as was pointed out in a previous report, the infestation was a new one, and it seemed wise to place the work in the hands of an agent supplied by your department. The results have been very gratifying, but constant watchfulness and work will be necessary during the coming winter to protect the reservation, especially as the infested area about the borders, chiefly in the Quiney granite quarries, has increased. The work in the other reservations and parkways has been in charge of employees of the Board, who now appear to have adequate experience and capacity for successfully handling the work. As Middlesex Fells was most seriously infested, following out the plan outlined in the previous report, the reservation was cleared of excessive undergrowth and of shrubs of the



Oiled hay band, Medford, 1906, necessary to keep swarming caterpillars from crossing road into properly cared for woodland.

non-flowering and unattractive sorts. Judicious thinning of the trees under the direction of an expert was extended over a large part of the reservation, the brush and smaller wood was burned, and the larger wood sold after creosoting all nests upon it. This work has of itself made a great improvement in the forestation of the reservation and in its availability as a place of resort for the public, and has materially reduced the number of trees necessary to be cared for. The creosoting of the nests was carried on with great fidelity wherever there were pines and hemlocks, and along the roadsides and over a strip from 200 to 500 feet wide along the borders. This work proved very effective. Less thorough creosoting was extended over nearly all the rest of the reservation. Subsequently the trees over most of the reservation were banded with Tanglefoot, and the caterpillars below the bands destroyed as thoroughly as the available money would permit. Later conifers and the trees along the roadside and the areas which seemed most likely to be defoliated were sprayed. Winrows of oiled hay were used for protection against the spread of the caterpillars in the most seriously infested sections. A considerable balance of the appropriations was for the first time kept for work in the autumn.

As a result, the permanent thinning and forestry work of the reservation was advanced almost to completion; no conifers were defoliated, the borders remained quite free from defoliation, practically no infestation went from the reservation out upon other lands or was allowed to come from without into the reservation, and infestation was thoroughly controlled in large areas and greatly checked throughout the reservation. Certain adverse circumstances limited the effectiveness of the work. It was so enormous that with no large appropriations available until February it could not get under way nor be carried on with complete efficiency. The Tanglefoot for banding could not be obtained in proper shape at an early date. The unusually dry weather of last spring made it possible for the caterpillars to spin a web over the Tanglefoot band and so cross to the foliage to a greater extent than ever was known before, a condition against which the limited number of men employed, under the appropriation then available, were powerless. In spite of these adverse conditions, however, no trees were killed and a great advance was made in the effectiveness of the work.

The balance saved for autumn and early winter work has made it possible to advance further toward complete work than in any previous year. It now seems possible to extend throughout the reservations the thorough work of creosoting which placed the pests under complete check in the sections in which it could be similarly employed last year. If the work can be continued with the same completeness throughout the reservations, it is believed that next summer will show entirely satisfactory results and a marked decrease in the expense for the ensuing year. If it is not so continued, the work will fall back again to its former con-

dition, and mean either a great loss of the best trees, or a still greater, instead of diminishing, expense in future years. This is particularly true in the Blue Hills.

The gratitude of the Board is due to your department for your co-operation at many points, to such cities and towns as did a greater amount of work than ever before in the lands surrounding the reservations and parkways, and to many private individuals who incurred great expense to protect neighboring lands. Especial thanks is due, and has been expressed by this Board, to Gen. Samuel C. Lawrence for the enormous expense of time and money which he incurred to protect not only his own woodlands but also those of others and the roadside trees in many places, and also for effective work which he did within Middlesex Fells in aid of the work being done by this Board.

It is a duty to urge that the work be continued in every direction, and that it be increased in the heretofore neglected woodlands in the borders of the reservations, particularly about the Blue Hills.

Thanking you and your assistants for many personal courtesies, I am
Respectfully yours,

W. B. DE LAS CASAS.

METROPOLITAN WATER AND SEWERAGE BOARD, BOSTON, Dec. 24, 1906.

Prof. A. H. KIRKLAND, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

DEAR SIR:—In response to your request, I submit the following brief statement regarding the work done by the Metropolitan Water and Sewerage Board during the past year in protecting the property under its charge from the ravages of the gypsy and brown-tail moths.

The greater portion of the work has been done on the 270 acres of land surrounding Spot Pond, but the gypsy moths have appeared in considerable numbers on the grounds around Chestnut Hill reservoir, along the aqueduct lines in Newton, Weston and Wellesley, and on the grounds surrounding the Weston reservoir. The nests of the brown-tail moths have been found not only where the gypsy moths were present, but also on land around the Sudbury reservoir in Marlborough, Southborough and Framingham, around Lake Cochituate, along the aqueducts in Natick and Wellesley, and on the grounds about the Wachusett dam in Clinton.

During January and February a force of about 25 men was employed on the grounds about Spot Pond in painting the egg clusters of the gypsy moth with a mixture of equal parts of creosote and fuel oil. In March and April the trees were thinned out and underbrush cut on about 50 acres of swamp north of the pond, and the trees on 150 acres were scraped and banded with Tanglefoot. The spraying of the foliage with arsenate of lead began on May 19 and was continued until the first week in July, the area covered being about 110 acres. For this work one steam, one gas and two hand spraying machines, together

with a force of about 25 men, were used. When all the machines were in operation about 200 pounds of arsenate of lead were used daily.

Adjoining the water works land at the south end of Spot Pond, for a distance of 2,500 feet, is land belonging to the city of Medford. This land was badly infested with gypsy moths, but nothing was done toward protecting the property. As a result, the trees were stripped of leaves, and great difficulty was experienced in preventing the caterpillars from entering upon the water works land and devastating that also. The most efficient means of preventing this was found to be a line of hemlock boards, 10 inches wide, set on edge along the property line and coated on one side with Tanglefoot. Hay, sprinkled with fuel oil, was also used for the same purpose, but proved less efficient.

The land around the Fells reservoir is in the custody and control of the Metropolitan Park Commission, but, as the trees in the vicinity of the reservoir were quite badly infested, with the consent of the superintendent of the Fells reservation those on a strip 50 feet wide surrounding the reservoir were painted with Tanglefoot, and large numbers of caterpillars were destroyed by our employees.

At Mystic Lake and at Chestnut Hill reservoir the egg clusters were destroyed and the foliage sprayed with arsenate of lead. At the Weston reservoir the number of trees infested with the gypsy moth was comparatively small, and the foliage was not sprayed. Where the caterpillars were discovered, bands of burlap were placed around the trees and the caterpillars killed.

On the lands around the reservoirs in Framingham, Southborough and Marlborough, and in the vicinity of the Wachusett dam in Clinton, a considerable number of the nests of the brown-tail moth were removed from the trees and destroyed.

As a result of the work done during the past two years, the number of gypsy moth egg clusters to be destroyed on the property around Spot Pond is very much less than last year, but at the Chestnut Hill reservoir and at the Weston reservoir the number has increased, this increase being due in some measure to the neglect of the owners of adjoining properties.

The total amount expended for the work on all the water works lands was about \$12,700, of which approximately \$10,500 was expended in protecting the lands around Spot Pond. The work of suppressing the gypsy and brown-tail moths has been under the direction of Mr. Dexter Brackett, engineer of the Sudbury and distribution department.

Respectfully yours,

HENRY H. SPRAGUE,
Chairman.

MASSACHUSETTS HIGHWAY COMMISSION, BOSTON, Jan. 30, 1907.

MR. A. H. KIRKLAND, *Superintendent for Suppressing the Gypsy and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

DEAR SIR:—In response to your request for a statement as to what was done last year by the Massachusetts Highway Commission in suppressing the gypsy and brown-tail moths on the State highway trees, I am directed by the commission to state that, acting under the advice which you were good enough to give the Board from time to time, the trees on the State highways in the cities and towns shown in the attached list were cared for. The expense of the work in each municipality is set opposite the name of the place. A total sum of \$7,337.07 was expended between Dec. 1, 1905, and Jan. 1, 1907.

In most of the towns the work was done by the local men, who were paid per diem rates for their services, as well as for the services of the laborers whom they employed to assist them, but a considerable portion of the work was done by contract with firms of contractors who make a specialty of tree work. It is believed that the work was done thoroughly, but that its cost was somewhat greater per unit than it should have been. The commissioners hope that, under the agreement recently made between the Board and yourself, the cost may be lessened. This agreement provides that you shall direct the work on the State highway trees as you do in other places, make contracts and employ the men, and that, after approving the bills, you shall send them to the commission.

Respectfully,

A. B. FLETCHER,
Secretary.

Acton,	\$11 10
Amesbury,	66 10
Andover,	60 00
Andover, Reading, North Reading, Stoneham,	836 50
Bedford,	22 54
Beverly,	629 50
Boxborough,	1 60
Brewster,	9 92
Burlington, Woburn, Winchester,	1,461 00
Chelmsford,	20 00
Cohasset,	48 89
Cohasset, Weymouth, Hingham, Quiney,	235 00
Concord,	182 02
Draeut,	5 00
Gloucester,	204 50
Groveland,	167 00
Hamilton,	245 64

Harvard,	\$1 20
Haverhill,	55 45
Hingham,	104 00
Lawrence,	3 00
Lexington,	541 48
Lincoln,	54 31
Littleton,	10 70
Lowell,	25 00
Marlborough,	944 17
Merrimac,	16 90
Methuen,	135 50
Newbury,	103 25
Newburyport,	80 50
North Andover,	12 00
Orleans,	1 50
Quincy,	5 00
Revere,	12 00
Rockport,	5 00
Rowley,	4 00
Salisbury,	28 65
Saugus,	24 00
Southborough,	2 25
Sudbury,	173 67
Stoneham,	12 00
Swampscott,	145 00
Tewksbury,	65 00
Tyngsborough,	10 00
Wayland,	44 60
Weston,	156 20
Wenham,	160 00
Westford,	20 70
West Newbury,	151 50
Yarmouth,	22 23
<hr/>	
Total,	\$7,337 07

WORK OF GEN. SAMUEL C. LAWRENCE.

Reference to the work of Gen. Samuel C. Lawrence of Medford has already been made in this report. So important has been the assistance received from him in connection with operations at Medford that the superintendent thinks it well to include at this point a somewhat detailed statement of the same as a conspicuous example of what a public-spirited citizen has done in combating the gypsy moth.

During the year 1906 General Lawrence has taken care of most of the territory in the city of Medford bounded on the west by land of Shepherd Brooks, Oak Grove Cemetery, Woburn Street and Hastings Lane; on the south by High Street to the square; on the east by Forest Street; and on the north by the Border Road of the Middlesex Fells reservation, excepting such home estates as their owners have protected, and one large lot of woodland on Forest Street unfortunately not satisfactorily treated. The territory cared for comprises 664 acres, of which 580 acres are woodland.

He has taken care of 154 acres of woodland and several home estates east of Forest Street, and of a number of estates south of the Mystic River.

In Winchester he has cared for 101 acres east of Highland Avenue and south of the Border Road.

In his work on all this territory, comprising 919 acres, he has applied, with the exception of the use of Cook's tree protectors, the same methods he has used on his own lands, where the moths are to-day practically under control. The operations have included the felling of trees to thin the woods, trimming trees (especially of dead wood), cutting underbrush to thin it, protecting trees with bands of Tanglefoot, burlapping trees, spraying foliage with arsenate of lead to poison caterpillars, the destruction of caterpillars under burlaps and elsewhere by hand and otherwise, crushing pupæ, creosoting the egg clusters of the gypsy moths and destroying the nests of the brown-tail moths.

General Lawrence has put Cook's tree protectors on the trees for $1\frac{1}{2}$ mile on Forest Street, from the square to the estate of Edward W. Mitchell; and has banded with Tanglefoot the rest of the trees on the street as far as Border Road. He has also put the protectors on the trees on Highland Avenue, Water Street, Oakland Street, High Street from the square to Woburn Street, Woburn Street, and Winthrop Street from Winthrop Square to Oak Grove Cemetery, — a total distance of 4 miles of streets well lined on both sides with trees. Several thousand Cook's protectors have been elsewhere applied to trees, mostly large and isolated, to insure lasting results.

He has sprayed the trees on 26 acres of homesteads lying between Main Street, Mystic Avenue and Hancock Street, to destroy moths and elm-leaf beetles. He has sprayed a lot of 24 acres of woodland on Forest Street, and has treated the gypsy moth egg clusters, to a distance of 15 feet from the ground, on about one-half the trees.

In the Middlesex Fells reservation he has sprayed about 327 acres of forest land, and has treated the egg clusters to the 15-foot limit on the trees.

He has sprayed 145 acres, mostly woodland, owned by the city of Medford and bounded by Forest, Elm and Fulton streets on the west and east and partly by Half Mile Road on the north; and has thinned the trees and underbrush and removed the dead limbs and dead trees thereon, cutting about 200 cords of wood. He has treated the egg clusters to the 15-foot limit on all the trees, and intends, if possible, to complete on them this winter the destruction of both gypsy moth eggs and brown-tail moth nests.

The total number of acres of land cared for by General Lawrence in 1906 was 1,441, or $2\frac{1}{4}$ square miles of seriously infested territory.

EDUCATIONAL WORK.

Because the work against the moths is so largely dependent upon the co-operation of the public, and because there is so great need that citizens should be thoroughly informed concerning the habits of the insects and the best means for combating them, we have kept up throughout the year educational efforts practically along the same lines as in 1905. A large number of illustrated lectures have been given by the superintendent and by the agents, while the public lectures by Prof. W. L. Underwood of Belmont and the Hon. C. O. Bailey of Newbury have been most helpful. Our Bulletin No. 1, which gave in concise form the information necessary to owners of infested estates, and of which an edition of 25,000 was printed in 1905, became exhausted early in the year, and has been reprinted with certain new illustrations and additional matter in an edition of 10,000, of which a large part has been distributed. Posters, briefly instructing property owners how best to fight the moths, were

issued in the spring and again in the fall of 1906, and were placed throughout the infested district in stores, post-offices, railroad stations and other places of public resort.

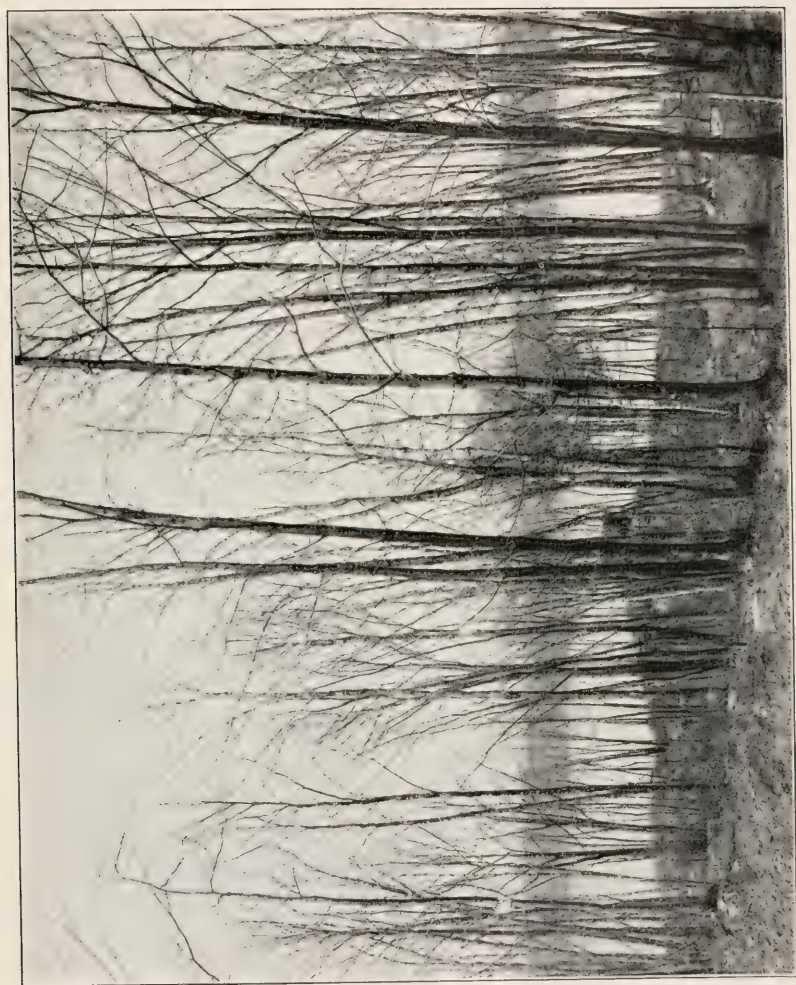
Particularly helpful has been the cordial assistance given by the press of the State. Our leading newspapers, realizing, no doubt, that the success of the State work depends almost entirely upon the co-operation of all, have shown a most commendable willingness to spread timely information concerning the moth pests, and in this way have materially assisted this office in its educational work.

The most important single feature in connection with educational work has been the unexpected but valuable assistance of the Massachusetts Society for promoting Agriculture, which at various times throughout the year added to its already long list of philanthropies by preparing and distributing at its own expense to the press of the State timely articles on how best to fight the moths. These articles, widely copied and read, gave in concise form information necessary to property owners desirous of destroying the moths.

During the caterpillar season there was held (June 27) at Pine Banks Park, through the co-operation of the park trustees and the local authorities of Melrose and Malden, a public field day. An exhibition of various methods of summer work was given, and a large number of spraying outfits of various types, insecticides and other devices for fighting the moths were shown. The occasion, designed with particular reference to the local superintendents, was most helpful to all who attended.

THE WOODLAND PROBLEM.

While the work against the moths has been noticeably successful wherever vigorously conducted, it has only been possible to carry it on in residential districts, along highways and in public parks. The great woodland problem practically remains untouched, and must remain so until suitable funds are provided with which to take it up. It is not difficult to clear street trees and residential sections from the moths, granted sufficient local appropriations and proper local management; but in the central towns several thousand acres of low-value woodlands are simply teeming with the gypsy moth. The



Woodland of Lynn Water Board, defoliated by gypsy moth caterpillars, July, 1906.



owners in nearly every case are most unwilling to meet the cost of cleaning these woodlands, and frequently cannot afford to do so. On the other hand, the towns and the State have not the funds to clear them of moths under the law, and yet they constitute a most serious menace to all adjacent territory. Experience shows that it is impossible to keep any residential district reasonably clear of the gypsy moth when large areas of infested woodland exist in the vicinity. We have been forced, then, to consider the only available expedient under the circumstances, which is to isolate such infested woodlands as far as possible, and to prevent at least the hordes of caterpillars from reaching roads and streets, and thus becoming scattered over a wider area. After several conferences with interested persons, the superintendent has practically decided upon this plan. A limited amount of work along this line was done in 1906, and more, it is hoped, will be done in 1907.

The cheapest and most effective way of isolating the woodland colonies is to thin out a protective belt of trees for, at least, 100 feet around their borders. In this belt damage by the moth can be prevented by burning over the ground, banding trees and the liberal use of arsenical sprays. Thus insects may be corralled, as it were, and prevented from spreading. Within the area of severe infestation this *laissez-faire* policy will, of course, result in the death of all pines and other conifers, together with many of the hard-wood trees. On the other hand, we have reason to believe that if its feeding grounds can be enclosed, the moth, though it may kill off the more valuable trees, will ultimately starve itself out, and leave at least trees enough to shade the ground. This treatment is an heroic one, disastrous alike to the owners of the woodlands and to the public; yet it seems the best that can be done under the circumstances, unless large appropriations are made available.

THE ORCHARD PROBLEM.

Next to the caterpillar-devastated woodlands, the generally infested orchards throughout the entire district offer the most difficult problem in connection with our work. Even in towns remote from those where the gypsy moth is most abundant, as Carlisle, Chelmsford and Pembroke, there are numerous or-

orchards badly infested by the moth, which, if neglected, are bound to serve in the near future not only as local pest spots but also as centers of distribution. These orchards are full of neglected trees, but are a moderate source of revenue to their owners, hence cannot be cut and burned. On the other hand, they are of low valuation, hence the owners' liability, under the one-half of one per cent. clause, will not begin to be enough for their proper care. This throws back upon the towns the cost of clearing the orchards of the moth; and, as these towns in turn are usually of low valuation, the State in the end must bear the major part of the expense. Here we are again confronted with the lack of suitable appropriations by the State. The superintendent believes he has done the best he could with this difficult problem. Towns have been inspected and infestations located; owners of orchards have been induced to cut hollow and worthless trees wherever possible; a general tinning and cementing campaign has been inaugurated and insisted upon in order to destroy the hiding places of the moth; and trees have been burlapped and properly attended, and sprayed as far as possible. But it is only honest to say that a mere beginning has been made in this important work, and that in most towns the orchards are in worse condition now than a year ago. More money will be needed for this work if we are to hold our own. Much money will be needed if we are to make a gain.

The importance of clearing infested orchards needs no explanation to any one familiar with the gypsy moth. The birds carry the caterpillars from them in large numbers in the early part of the season; and the danger of transportation of caterpillars by human agencies and of moth nests on barrels or fruit crates needs but mention to be fully understood. The superintendent is convinced that but two courses of action remain open, if the important orchard problem is to be properly dealt with. Either we must have large appropriations on the part of the State, adequate to meet the needs of the situation, or we must adopt a new system of horticulture by which a man shall be allowed to keep only such fruit trees as he may be able to care for properly. It is an open question whether the latter course would not be more advantageous to the owner, as well

as more effective in suppressing the moth. A few fruit trees well cared for will yield greater returns at slight expenditure than many trees neglected.

PRELIMINARY OPERATIONS.

In the effort to destroy the gypsy moth in a wholesale manner, certain preliminary operations are necessary. These operations in themselves may not involve the actual destruction of the insect, but are required to prepare the way for economical and effective work. If all the trees in the infested district stood apart at suitable intervals, if there was no underbrush in the woodlands or along roadsides, and if there were no hollow and worthless apple trees in orchards, then the combat against the moth would be comparatively an easy matter. But unfortunately such ideal conditions can only be found in countries where intensive forestry methods are practiced, and where orchards receive the constant care which is their due.

Our Massachusetts woodlands are commonly a mass of crowded, choked growth, with ten trees, it may be, struggling for existence where but one can properly reach maturity. Our roadsides are too often but a tangle of brush and vines, — picturesque, it is true, but enormously expensive to clear of moths; while our orchards, planted generations ago, are as a rule but an aggregation of neglected, unpruned, hollow and diseased trees. These conditions call for much preliminary work before the moth can be fought to advantage, and the principal operations of this class are described below.

The tendency of nature is to attempt to grow many more trees on a given area of ground than can possibly reach maturity, leaving the harsh law of "the survival of the fittest" to crowd and kill out the weaklings, until after the lapse of time only the strongest species and most vigorous specimens survive. A judicious thinning of such woodlands, even up to the time when many of the trees are mature, is of direct benefit to the remaining trees by enabling them to make more perfect growth and reach larger size.

In combating the gypsy moth in woodlands such thinning is imperative. In the first place, it is impossible to spray to advantage until the trees have been so thinned as to permit the

use of power outfits and the free movement of ladders and hose. Furthermore, the use of burlap on the trees is often as desirable as spraying; and to burlap and attend the trees in the average woodland is infinitely more expensive and less effective than where proper thinning operations have been carried on.

The first step, then, in clearing woodlands of the moth is to reduce the number of trees per acre, so as to permit of economical work and to give the remainder the best conditions of growth. In general, it may be said that pines and chestnuts require less ground space than oaks or other trees of natural broad expanse of limb. The method followed in all cases has been first to cut the brush and other low growths. This, though destroying for a season the ground cover, and with it many seedling trees, is necessary to force the insects to the larger trees remaining. Next, all dead, diseased, misshapen and crowded trees are cut. The dead or diseased tree is valueless except for firewood, and often not for that, and it frequently harbors gypsy moth nests by the hundred. A lop-sided or deformed tree is equally worthless, yet affords feeding ground for caterpillars and nesting places for the moths.

Nearly all our hard-wood forests consist of sprout growth, — the surviving suckers which have sprung from stumps of former trees. Cut an oak or chestnut to-day and next season one finds ten, twenty or fifty little sprouts pushing their way upward and struggling year by year for light and life. In the course of ten or fifteen years but eight or ten of these survive, and this number is gradually reduced until at the end of twenty or twenty-five years but three or four remain. This clump of sprout trees is worth little in comparison with a single sound tree, as any lumberman knows. To facilitate our work, as well as to benefit the future forest, the weaker trees in such clumps are cut and the strongest specimens left. This in general is the practice we have followed. It results in leaving only the best and soundest trees, thus being a direct benefit to the owner of the woodland, and at the same time clearing up the woods so that future operations against the moth may be carried on economically and effectively. In all thinning opera-

tions care has been taken to cut the stumps close to the ground, in order to eliminate as far as possible favorite nesting places of the moth.

Roadside Clearing.

Our New England roadsides are proverbially rock-bound. In the walls bordering our highways the gypsy moth finds an ideal nesting place. Thus for example, at Woburn this year a roadside wall yielded moth nests by the thousand, as many as 50 or 60 egg clusters being found on single stones not over a foot in diameter. Hatching in such secure places, caterpillars swarm to feed on the ever-present brush, and later ascend the street trees and from them spin down in swarms on passing vehicles, to be transported often many miles to establish new colonies. It is an absolute impossibility to stop the spreading of the moth and the consequent increase in area of the infested district so long as the roadsides are infested. This necessitates the cutting and burning of roadside brush (leaving at suitable intervals trees for shade) as one of the first preliminary steps in destroying the moth.

Next, in severe cases of infestation the walls are burned out and the ground burned over with an oil flame. Whether this burning is done or not, the caterpillars, as they appear, are driven for food to the remaining trees, there to be intercepted by bands of sticky material, to be caught under the burlap, or to feed on well-sprayed foliage. To those who do not appreciate how thoroughly and persistently roadside brush fosters and retains moth colonies, such growth is one of the most beautiful things in nature. But if the spread of the gypsy moth is to be checked, many of our brush-bordered roadsides must be sacrificed. After the necessary moth work has been accomplished, nature will soon replace the plants and shrubs which formerly delighted the eye. In any event, it would be far better to have bare roadsides for a long term of years than to permit the gypsy moth to continue its spread into non-infested territory, there ultimately to work as great harm as it has done in eastern Massachusetts.

Treating Orchard Trees.

Orcharding in Massachusetts for the last generation or two has not received as much attention as formerly, notwithstanding the ever-increasing demand for orchard products. It results, therefore, that where we find one young, thrifty, well-cared-for orchard, there are twenty, if not one hundred, neglected orchards, full of scraggy, hollow, untrimmed and uncared-for trees. Such trees afford excellent breeding places for the gypsy moth; and to clear them of this insect is most difficult, unless suitable preliminary work is done. One of the principal preliminary operations in connection with clearing the moths from old orchards is to decide first what trees are worth preserving, and what should be cut and burned. Many old apple trees have trunks that are but mere shells, hardly able to support the stunted top growth of branches, but harboring gypsy moth egg clusters by the hundred. All such should be treated with the axe *close to the ground*, and burned on the spot. Trees standing too thickly may also be thinned, to the great benefit of those that are spared. Full-grown apple trees should be spaced at least forty feet apart, in order to afford suitable feeding area and the proper exposure to light and air necessary for ripening and coloring all the fruit.

Trimming Operations.

The trimming of orchard trees, particularly the many varieties of the apple, might not at first sight seem to have a special bearing on the work against the gypsy moth. An examination of any old infested orchard, however, will show at a glance that badly trimmed or neglected trees harbor the insect in much greater numbers than those which have been properly cared for. In the first place, neglected trees have a dense, thick growth, and beneath their numerous branches and rough bark the moth finds ideal conditions for nesting. On the other hand, a tree imperfectly trimmed soon develops cavities, which, decaying deeper and deeper year by year, afford those dark holes so much sought by the caterpillars for transformation and by the female moths for egg deposition. It is, therefore, impor-

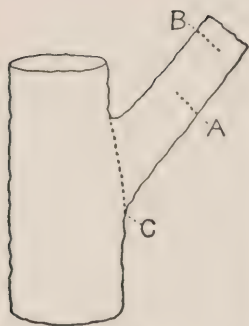


FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.



FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.




FIG. 9.

Fig. 1. Proper method of removing a large branch. Fig. 2. Branch broken down from cut wrongly made. Fig. 3. Dead stub left to rot back. Fig. 4. Stump of branch left by bad pruning. Fig. 5. Same, three years later. Fig. 6. Decay resulting from bad pruning. Fig. 7. Cemented cavity. Fig. 8. Tinued cavity. Fig. 9. Burlapped cavity.

tant that all orchard trees should be so trimmed as to leave the least possible shelter for the moths at egg-laying time; and that in all trimming operations the removal of branches should be so accomplished that no cavities may result. To this end a general opening up of the tree is advised, and this is the practice of the best fruit growers of the country. It is important that the cuts made in removing the branches should be smooth and close to the trunk, in order to insure a proper healing of the wound. Where large branches are cut off, the first incision should be made from below and the second and main cut from above, so that as the branch falls there shall be no tearing down of the sap wood. Usually a cut of from one-half to one and one-half inches on the lower side, dependent upon the size of the limb, will suffice. Then the branch may be sawed off from above in the usual manner, care being taken to make the cut close to and parallel with the main trunk or branch. (See Plate, Fig. 1.) Next, an application of coal tar or paint should be made over the entire surface of the cut, and for this purpose an ordinary stencil brush will be found very useful. This treatment has a double effect. It excludes air from the wound, and also prevents the admission of fungous growths which cause decay. For the latter reason, coal tar, containing as it does a large percentage of carbolic acid and naphthaline substances of high germicidal powers, is especially effective.

There are to-day in Middlesex Fells numbers of white oaks which were so trimmed and treated in the process of removing large limbs in 1895 that no decay has occurred. At the present writing the scars caused by the removal of these large limbs have closed over in an entirely satisfactory manner. On the other hand, there may be seen in every town improperly pruned fruit and shade trees, where proper precautions were not taken, and where cavities often extending to the heart of the tree have resulted. (See Plate, Figs. 2-6.) Thus, by constantly keeping in view the future effect of pruning operations on the tree, it is possible to do this necessary preliminary work in such a way as to prevent the formation of hiding places for the moth, and at the same time materially benefit the tree.



Cementing.

Had all the trees in the infested region, particularly those in orchards, been properly trimmed, it would be unnecessary to speak of cementing operations. But unfortunately much of the little trimming of orchards that has been done has been done poorly, and as a result the majority of trees throughout the district are full of cavities which would not have developed had the branches been correctly removed and the wounds properly treated. In preparing such orchards for exterminative work against the gypsy moth it is necessary to eliminate as far as possible all hiding places of the insect. To this end, therefore, much closing of cavities by cementing or otherwise is required in the case of trees which are to be preserved. Generally speaking, the use of cement is preferable to other methods, because of the ease with which it is applied, its economy and its adaptability to a wide variety of conditions.

In cementing cavities it is necessary first to remove as much as possible of the decayed wood, so as to get a sound surface on which to work. Next, all large cavities should be packed full of stones pounded tightly together, so that the cement plug shall not fall inward, and thus afford egress for any insects confined within or ingress to those without. The orifice of the cavity should be cut away on a bevel inward, so that its interior diameter shall be greater than that of the outer edge. Then the cement should be thoroughly worked in and brought flush with the cambium layer of the tree, being depressed on the average about one-fourth of an inch from the outer surface of the bark. If these directions are followed, the cement cap can never fall outward, and a natural growth of the tree will hold it more tightly in place from year to year until the wound is fully closed. (See Plate, Fig. 7.)

Tinning, etc.

In treating orchard and other trees, cavities are often found which will not permit of cementing, and these may be closed by tinning, or in some cases by the use of heavy burlap. In tinning cavities it is desirable to cut back into the sound wood

for a slight distance, rabbeting the edge of the wound, so that the tin may be placed about one-fourth of an inch below the surface of the bark. A piece of tin cut in proper shape is then securely tacked over the cavity. For this purpose the use of large tacks is necessary. It is often practicable to secure the necessary supply of tin from cans and other waste material found on dump heaps. Old tin roofs, particularly those laid many years ago, when the quality of tin plate was much superior to that which can be obtained at present, are also much sought after for this work. In all cases the tin cap should be thoroughly painted or covered with coal tar on both sides, to prevent rusting. (See Plate, Fig. 8.)

In cases where trees have been split by frost, or where the cavity is of such irregular shape that it is impossible to close it tightly by tinning, the use of a double layer of heavy burlap is advised. For this purpose burlap of the heaviest and coarsest quality is recommended, both layers being liberally treated with coal tar, to prevent decay. (See Plate, Fig. 9.) As a rule, trees so badly fissured or decayed that it is impossible to cement or tin the cavities should be cut down. The above general considerations, written with particular reference to orchard trees, will apply equally to shade or forest trees which it may be desirable to preserve.

The time for pruning operations is a moot point with horticulturists and foresters, and in discussing it we are often obliged to fall back upon the familiar directions of unknown authorship, — "Trim when you have time and a sharp axe." A safe rule to follow, however, is to carry on trimming operations when the trees are dormant, particularly during the fall and early winter months. Trimming done at this time seldom results in much bleeding of the trees, as the wounds generally dry out before the sap starts in the spring, except with the maples. In the case of these trees it may be well to say that during some twelve years' observation on the part of the writer no injury has been noted from wounds, notwithstanding the liberal spring flow of sap where branches were removed.

BANDING TREES.

In addition to the general use of burlap bands, there has sprung up during the last two years a quite common practice of banding trees with sticky materials to prevent the ascent of gypsy and brown-tail moth caterpillars. While tar, printer's ink, lard, raupenleim and bodlime have all been used with varying degrees of success, the material most generally employed is that sold under the name of Tanglefoot. This substance consists principally of resin softened by the admixture of suitable oils. It is quite similar to that used in the manufacture of adhesive fly-paper, seems to possess the merit of not injuring the trunks of trees, and is very effective in checking the ascent of caterpillars thereon. It has given the most satisfactory results when used in woodlands where thinning operations have been carried on, but where no effort was made to destroy thoroughly the gypsy moth egg clusters on the ground, rocks and stumps. In thinning badly infested woodlands it is cheaper by far to cut trees without reference to the number of egg clusters occurring on them. When these trees have been put into cordwood, and the brush cut and burned, the ground is usually thickly strewn with broken gypsy moth egg clusters. If in the following spring the remaining trees are banded with some suitable adhesive substance, and properly attended, the small caterpillars will starve in large numbers for lack of food. As an additional means of destruction, the ground should be burned over with a light fire as soon as possible after the eggs have hatched. In such sections the sticky bands are most helpful. Their use is also to be recommended on trees on private estates where the egg clusters have not been thoroughly treated on rocks, fences, etc. The important thing in all cases is that in the early part of the season, when the caterpillars are small, the sticky bands shall receive constant attention, the young insects collected beneath being crushed by the use of steel brushes.

The experience of past years fully confirms the value of the burlap bands, particularly on street trees and those standing in areas where thorough winter work has been done. Where the burlaps are well attended, upward of 90 per cent. of the caterpillars coming from scattered eggs will be taken during

the season. The general use of the burlap on street trees cannot be too highly commended, in preference to the sticky bands. The results of our fall inspection show repeatedly that where street trees were banded with sticky material, gypsy moth nests may often be found scattered over all parts of the tree. On the other hand, where the burlap was applied and thoroughly attended, but few nests high up in the trees, and in fact but few nests anywhere, may be found. Speaking in this connection, Mr. C. W. Ross, the local superintendent at Newton, who was induced to try the burlap on a limited number of trees as an experiment last season, states that not over one-fifth the time is required to clear the burlapped trees of gypsy moth nests that is required where no burlap is used.

In the case of the average property owner, it may be said that, if he will give the burlaps thorough and daily attention, their use is preferable to that of the sticky bands. On the other hand, if he is disposed to neglect summer work against the caterpillars, the use of such bands is preferable. It often happens that a combination of sticky band and burlap is advisable, particularly in places where clean ground work has not been done, or where there is danger of the caterpillars swarming from adjoining woodlands. Where the combination band is used, the burlap should be placed above, to afford shelter to the descending caterpillars, while the sticky material beneath will prevent additional insects from ascending the tree.

TRAPPING BROWN-TAIL MOTHS AT LIGHT.

Because of the very large number of brown-tail moths seen fluttering around electric and other lights at night during the flying season in the middle of July, it has been thought by many that by the use of a suitable lantern trap large numbers of the insects could be easily destroyed at a trifling expense. That the lamps were an important factor in destroying the moths was also the view taken by the writer (based, it must be admitted, upon general observation rather than specific data) at the time he made a study of the insect in 1897, the results of which were published in the special report on the brown-tail moth in 1903. The great abundance of the moths around the lamps led to certain interesting experiments during the past

year; and the writer went to some pains to collect the moths so taken, and examine them to determine the percentage of males and females. Since one male moth is capable of fertilizing several females, the destruction of males is of but slight importance. On the other hand, if nearly all the lamps attracted female moths, the destruction of the insects in this way would be of great value.

At Belmont Prof. Wm. Lyman Underwood had constructed two large wire frames covered with cloth to which were attached sheets of sticky fly-paper, the whole apparatus being suspended around powerful arc lights. Professor Underwood has kindly placed his notes at the writer's disposal. These show that in a full week the two traps caught a total of 2,036 male moths and 68 female moths. At Brookline, during the last flying season, quite an extensive experiment was made under the direction of Mr. James H. Bowditch. Boards covered with Tanglefoot were fastened beneath arc lamps. These boards were examined by Inspector Joseph Silva of this office on three consecutive nights, at the height of the flying season. The examinations were made before sunrise, with the result that upon 32 trap lamps 1,579 male moths and 51 female moths were taken. In the observations made by the writer in 1897, previously mentioned, the globes of 5 lamps were examined between 3 and 4 o'clock in the morning, with the result that 297 males and 92 females were found. It should be said, however, that this observation was made late in the flying season, when the female moths predominated.

Summarizing the results of these three examinations, all carefully made, we have a total of 39 lamps under observation, with 4,123 moths taken, of which 3,912, or 94.8 per cent., were males, and 211, or 5.2 per cent., were females. It is thus apparent that, while the lamps attract large numbers of moths, they are principally males, and that the females are not sufficiently attracted by light to warrant the use of lamp traps. These results are unfortunate from the standpoint of those engaged in suppressing the moths, but in the interests of scientific accuracy should be placed on record. Further comment on the efficacy of lamp traps seems unnecessary.

BROWN-TAIL MOTH POISONING.

The highly poisonous properties of the brown-tail moth caterpillars are only too well known to suffering humanity in eastern Massachusetts. This poisonous quality appears in the tiny caterpillars in the webs, continues with increasing force as the caterpillars approach maturity, and is also present in full virulence in the cocoons and to some extent in the female moths. It is caused by the development of certain poisonous hairs on the body of the caterpillar, which are later cast off in molting or in spinning the cocoon, and which also become attached in greater or less numbers to the body of the moth in its struggles while emerging from the cocoon. Naturally, from the large tuft of hairs at the tip of the body of the female moth, the winged insects of this sex are more poisonous than the males. Indeed, in certain years, at the height of the flying season of the brown-tail moth, motormen in charge of electric cars in country districts, where high-power searchlights are commonly used, have been obliged to wear gloves and veils to protect their faces and hands from the winged insects which were attracted by the rays of the strong lights on the front of the car.

Our investigations, together with those of many physicians, have shown that this poisoning soon spreads from a single point of infection over a considerable part of the body, and for this reason it has been generally believed that the hairs possessed some poisonous principle which was absorbed by the blood and was thus diffused over a greater or less area, causing the well-known and highly painful irritation. On the other hand, investigations made some ten years ago by Mr. F. J. Smith, formerly instructor of chemistry at the Massachusetts Agricultural College, gave only negative results, so far as determining the presence of any poisonous principle. Mr. Smith tested the caterpillar hairs with a wide range of solvents, and could find no organic acids or alkaloids. To quote from his report, his opinion was: "Hence, I am led to believe that the irritation is of a mechanical nature, caused by the brittle, finely barbed hairs, and not due to a toxic principle." Mr. Smith's studies were in no sense complete, but these results were accepted for a time as based on the only effort made by a competent chemist

to investigate the poisoning properties of the hairs. The general spreading of the brown-tail moth throughout eastern Massachusetts, and the consequent development of the well-known summer disease of caterpillar dermatitis, as it is known to the medical profession, led the writer repeatedly to urge medical students, physicians and others to take up the subject and make an exhaustive study of it. The importance of such an investigation appealed strongly to Dr. E. E. Tyzzer of the Harvard Medical School, who independently took up such an investigation the past summer. The results of his studies are embodied in the paper presented herewith, which he has kindly allowed me to publish in the present report, and which will commend itself to all as a most excellent and thorough piece of scientific work. Briefly stated, Dr. Tyzzer shows that the poisoning by the caterpillars, contrary to Mr. Smith's conclusions, is caused by a specific poisonous principle, which works certain important and easily recognized changes in the blood, and which in turn accounts for the spreading of the caterpillar rash to various parts of the human body from a single point of infection.

It may be stated, in connection with the subject of brown-tail moth poisoning, that, while there are on the market a host of proprietary remedies, many of which possess merit, the prescription which has given the greatest relief in actual practice is: carbolic acid, $\frac{1}{2}$ drachm; zinc oxide, $\frac{1}{2}$ ounce; lime water, 8 ounces; shake thoroughly, and rub well into the affected parts. At our parasite laboratory, where during the past year at least one million brown-tail moth caterpillars in all stages of development have been handled by the assistants, many of whom suffered so severely as to become seriously ill, this remedy proved the most effective in treating the caterpillar dermatitis.

THE PATHOLOGY OF THE BROWN-TAIL MOTH DERMATITIS.

By E. E. TYZZER, A.M., M.D., Assistant in Pathology, Harvard University, and Director of Research, Caroline Brewer Croft Cancer Commission.

The disagreeable dermatitis caused by the brown-tail moth has attracted much attention in the vicinity of Boston in recent years. At first of interest chiefly to dermatologists as a skin affection new to this region, this dermatitis has since become so common in moth-infested districts that it is now recognized by laymen as well as by physicians.



Effect of brown-tail moth hairs in human blood: 1. The rolls of corpuscles break down and separate. 2. The corpuscles lose their smooth outline and become spiny.



So much has been written concerning the brown-tail moth (*Euproctis chrysorrhæa*) that it is unnecessary to review its life history and habits in this paper. Full information on these points, together with an account of the introduction of the moth into this country and its subsequent multiplication, is given in the report of Fernald and Kirkland (7).¹

In June, 1901, Dr. J. C. White (17), in a letter to the editor of the Boston "Medical and Surgical Journal," called attention to a peculiar type of dermatitis, which he thought was undoubtedly due to the caterpillar of the brown-tail moth. The dermatitis, which was urticarial in character, usually occurred on the neck, although the face and hands were sometimes affected. All patients afflicted gave history of the removal of a caterpillar from the parts affected just prior to the appearance of the eruption. Soon after this, Dr. E. R. Meek (11), likewise in a letter to the editor of the Boston "Medical and Surgical Journal," ascribed the dermatitis to the hairs of this caterpillar, since these elements are very brittle and easily detached. Fernald and Kirkland, in the report already referred to, state that the irritation is produced only by certain short barbed hairs, which they term "nettling hairs," and by no others.

The irritating properties of species closely allied to the brown-tail moth have long been known to European entomologists. There is in the London "Entomologist" a series of notes recording the observations of a number of entomologists who have experienced irritation of the skin after handling specimens of these closely allied species. In the year 1865, South (14), after collecting specimens of *Porthesia similis*, experienced intense itching, urticaria about the neck and edema of the eyelids, but did not at that time ascribe the condition to the handling of the moths. Rendall (13) found that the cocoons as well as the larvæ of the moth may produce irritation. Anderson (1) found that handling the imagoes of *Liparis auriflua*, another species closely allied to the brown-tail, was followed by urticaria. He further states that merely to walk, during a breeze, by certain hedges infested by this species is sufficient to produce the rash. Swinton (15) held the opinion that the hairs of the caterpillars are coated with a poisonous substance, which exudes from the scarlet warts on the hinder segments. The fact that cocoons, empty and exposed to the weather for months, are still capable of producing the rash, seemed to Cockerell (5) and others to militate strongly against the theory that the effects are caused otherwise than by the mechanical action of the hairs.

An interesting series of experimental inoculations is furnished by Carter (3). He inoculated his own skin with various species, with the following results: *Porthesia similis* produced redness, itching, pimples,

¹ The figures enclosed in parentheses refer to the list of reference works appended to this article.

and white vesicles on the skin; *Bombyx rubi* produced intense irritation, vesicles, some of which became pustular, and edema of the eyelids; *Bombyx quercus*, pimples which became vesicular and afterwards dried up; and *Bombyx nustria*, great irritation, but no vesicles. Inoculation with *Arctia caia* and *Arctia villica* was followed by transient irritation. *Dasychoia pudibunda* caused red patches, and vesicles resembling chicken-pox. Other species were tried, but proved to be innocuous. Thresh (16) calls attention to short hairs, $\frac{1}{200}$ of an inch long, and barbed throughout their entire length, but thinks that the long hairs as well have nettling properties. He states that the long hairs give an acid reaction when they come in contact with litmus. Perhaps the most notorious of the "stinging" larvæ is *Cnethocampa pityocampa*, the processionary caterpillar of Europe. Its poisonous properties were known to the ancients, as is shown by the fact that it is mentioned in the Cornelian law.¹ Keller (8 and 9) investigated this species, and found structures at the bases of the spines which he interpreted as poison glands.

There is in the Philippine Islands a moth (*Taragama igniflua*)² which resembles somewhat the brown-tail. Its nettling hairs were examined by the author, and found to be almost identical with those of the latter species, and capable of producing severe irritation. There were also long, needle-shaped, hollow spines, which were filled with fluid. As they were watched under the microscope the fluid rapidly evaporated, leaving the spines empty. Although these spines were well adapted for penetration, it was not determined whether they were instrumental in the production of the dermatitis. The larvæ of the Io moth (*Automeris io*) also produce irritation of the skin when handled. There is an immediate sensation of pain, similar in nature to that produced by the sting of a bee, but much milder in degree. There is some reddening of the skin, but the irritation is transient, and soon disappears.

The larger portion of the work upon which the present paper is based was done several years ago, when the moth first became prevalent in the suburbs to the north of Boston, but certain additional data have been obtained more recently. In investigating the nature of this peculiar skin eruption, the primary object was to determine by means of experimentation just how the lesions are produced. My observations confirm those of Fernald and Kirkland, that the dermatitis is produced by the peculiar, short, barbed spines or "nettling hairs"³ of the caterpillar. These hairs when rubbed upon the skin produce a dermatitis, but the other hairs of either the caterpillar or the moth produce no

¹ Kirby and Spence (10).

² Moore. Lepidoptera of Ceylon (12).

³ Such is the degree of protective specialization shown in these peculiar elements that the term "hair" furnishes but an inadequate conception of their character. On the ground of homology, however, the term "hair" seems justifiable, and the terminology of Fernald and Kirkland as regards these elements will accordingly be followed.

irritation. Furthermore, by serial sections of lesions produced experimentally, I have been able to demonstrate the nettling hairs imbedded in the skin. The most important result of this investigation is the proof that the action of the nettling hair upon the tissue is not a purely mechanical one, as the observations of Fernald and Kirkland and others tend to indicate, but that there is in addition an irritating substance. When this irritating substance is removed from the nettling hairs they are then practically innocuous, and, when inoculated, act merely as foreign bodies in the tissue.

The nettling hairs are of the form of straight, tapering, needle-pointed shafts, barbed for their entire length, after the manner of a certain form of African spearhead. They vary from .07 to .2 millimeter in length,—the average is about .1 millimeter, or $\frac{1}{250}$ of an inch,—and are not over .004 or .005 millimeter in thickness at the thicker extremity. They possess a thin, chitinous wall, from which project three rows of recurrent barbs; while the interior of the shaft consists of material which appears finely granular, and stains with the ordinary anilin dyes after fixation in Zenker's fluid. When the nettling hairs are thoroughly dried, they often contain air. No pore or opening is visible in these hairs, even on high magnification; but if they are dried, and then placed on a slide in some such stain as Loeffler's alkaline methylene blue solution, the dye is seen first to penetrate the point of the hair, and afterward gradually to diffuse itself through the remainder of its length. From this phenomenon it appears that there is a minute opening at the point of the nettling hair, although it can not be visually distinguished. When suspended in a fluid, individual nettling hairs appear to the unaided vision as brownish scintillating points. In the dry state large masses of them form a fine brown powder, which is very light and easily blown about.

The nettling hairs develop upon the caterpillar. Although Fernald and Kirkland and others state that the nettling hairs are present upon the caterpillar only after the last two molts in the spring, they are, nevertheless, demonstrable much earlier. The two velvety brown spots, which appear on the dorsal aspect of the fifth and sixth segments after the first molt, and while the caterpillars measure but 4 or 5 millimeters in length, are found to consist of nettling hairs. Sections of these small caterpillars show the anatomical relations of these hairs, and when the latter are rubbed upon the skin a dermatitis is produced. The caterpillar is thus demonstrated to be poisonous at a very early stage in its development. The young caterpillars hibernate in colonies in the winter webs which are found on the tips of twigs. These webs contain, in addition to the young caterpillars, the skins of their various molts, and may produce irritation if torn open. The two brown spots situated on the back of the caterpillar are in reality two pairs of subdorsal tubercles. They are likewise found on the fifth and sixth segments after each succeeding molt up to the last two spring molts, when they are present on

all segments from the fifth to the twelfth inclusive. Patches of nettling hairs are at this time also found just below the tufts of white branching hairs on the lateral tubercles of the same segments. The increase in the production of nettling hairs at this stage makes the caterpillar "poisonous" to a degree much greater than in any of its preceding molts.

The nettling hairs developing upon the caterpillar may eventually be widely disseminated from their original source. In the process of manufacturing the cocoon the hairs are all rubbed off the caterpillar and enter into the structure of the cocoon. It is unquestionably by reason of the nettling hairs enmeshed in and adherent to cocoons that a dermatitis so often follows contact with them. Since severe dermatitis has frequently followed the handling of cocoons over a year old, it is evident that the irritating substance connected with the hairs is, under ordinary conditions, extremely slow to disintegrate.

Nettling hairs are found mingled with the long hairs of the brown tuft on the tail of the moth where they are most numerous near the distal ends, and are not found near the roots of the long, coarse hairs. Although the nettling hairs are present in large numbers, especially on female moths, which possess a larger and thicker tuft on the tail, I have been unable to demonstrate that they have any constant anatomical relation to the body of the moth. Fernald and Kirkland, since they found these elements in variable numbers and irregularly distributed over the moths, concluded that they probably become entangled among the scales of the moth as it works its way out through the cocoon, and that thus all the nettling hairs are primarily derived from the caterpillar. The tuft of thick brown hair on the tail of the female is deposited in the form of a felt-work around the eggs as they are laid on the under surface of leaves. As this material contains many nettling hairs, it also is capable of producing the typical dermatitis.

Since the nettling hairs, once they are dislodged from the caterpillar, are blown about by any slight current of air, it seems beyond question that a characteristic eruption may occur without actual contact with caterpillar, moth or nests. If a susceptible individual stand during a slight breeze beneath a tree well infested with these caterpillars, this fact will be satisfactorily demonstrated. A rash will appear on the exposed parts very soon afterward, and one may experience intense itching almost immediately. The lodgment of the nettling hairs upon underclothes as they are hung to dry is probably also one of the common sources of the rash. To remedy this, underclothing may be hung right-side out instead of being turned, as is customary, or it may be sent to a non-infested district to be laundered.

In order to determine the anatomical relation of the nettling hairs, serial sections were made of several of those segments of the caterpillar which bear the velvety brown patches corresponding to the subdorsal and lateral tubercles. These hairs are found with the points inserted in protuberant rounded sockets, with which this portion of the

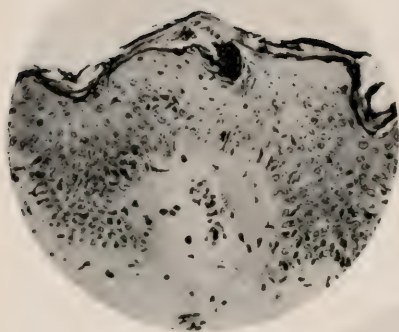


FIG. 1.

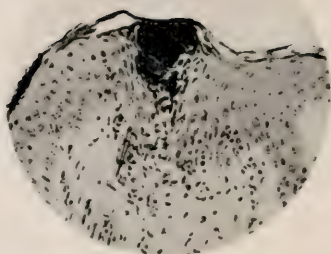


FIG. 2.

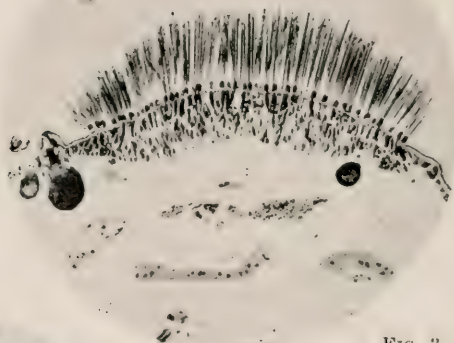


FIG. 3.

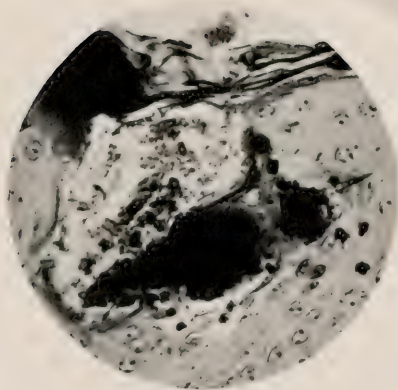


FIG. 4.

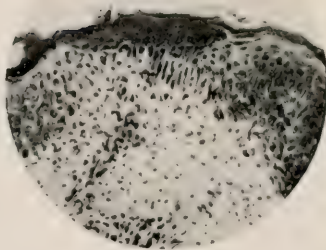
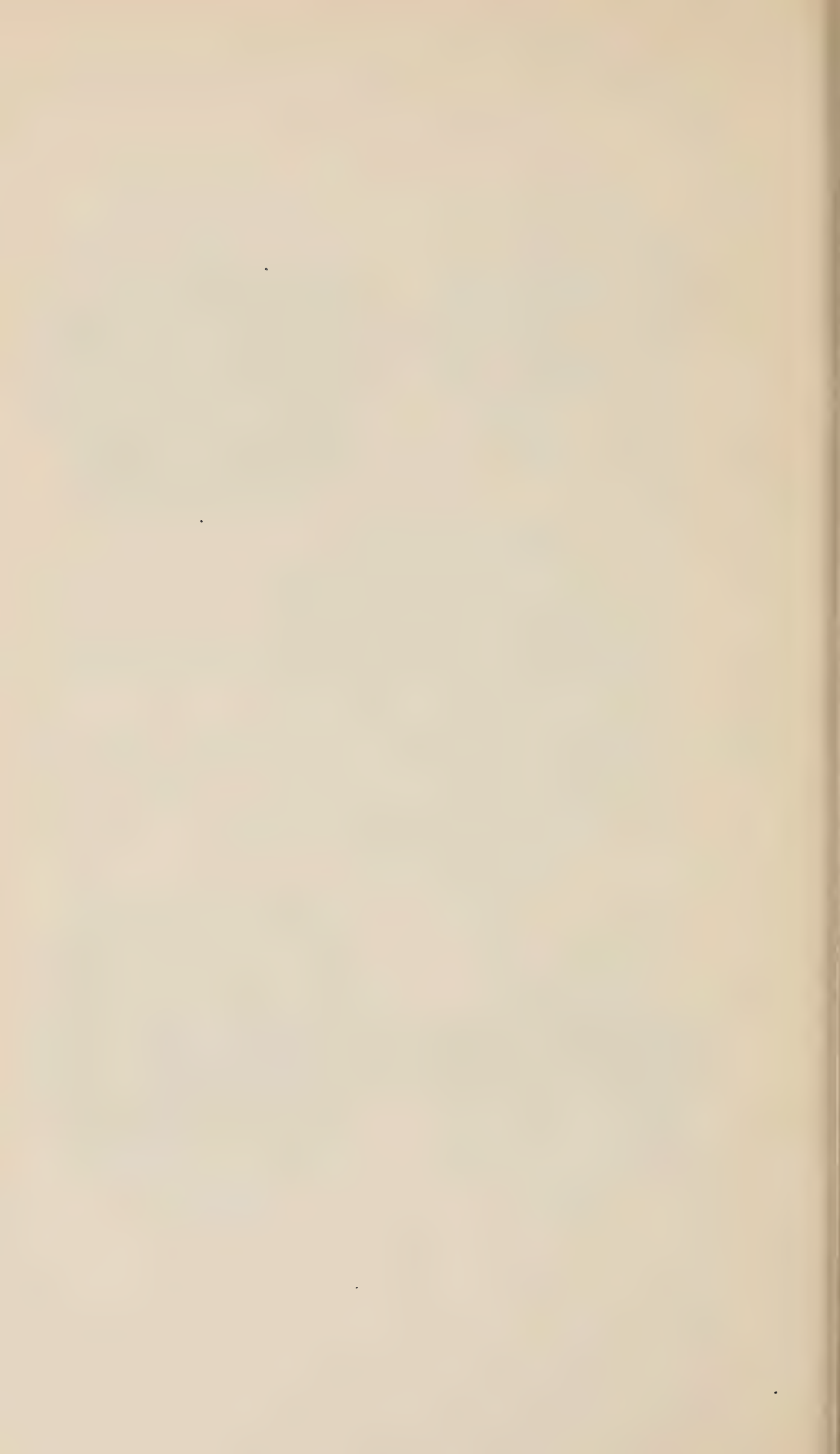


FIG. 5.

EXPLANATION OF PLATE.

- FIG. 1. Human skin, excised twenty hours after being rubbed lightly with a small brown-tail caterpillar. The nettling hair has penetrated only the superficial layers of the epidermis. About it a minute quantity of fluid separates the horny layer; its point is embedded in a mass of deeply staining coagulum in which are necrotic epidermal cells.
- FIG. 2. A section from another portion of the same piece of excised skin. The point of the nettling hair has in this instance passed through the epidermis and penetrated the corium. A more or less conical mass of sequestrum marks its course. A small number of leucocytes are present in the tissue about the injury. (Since the point of the nettling hair showed but faintly in this photograph, its outline has been sharpened for purposes of reproduction.)
- FIG. 3. A section of a caterpillar, showing the nettling hairs as they are developed upon its skin. An area of cuticle is shown, upon which are numerous rounded sockets, each of which bears a number of nettling hairs with their points inserted in the sockets. Below this area is a mass of long fusiform cells, and to the left is a large deeply stained cell marking the insertion of one of the coarse hairs of the caterpillar.
- FIG. 4. A minute cavity formed about a nettling hair which has penetrated the epidermis. Adherent to the nettling hair, the point of which is directed to the right, is a mass of deeply stained coagulum. The fluid in the cavity contains degenerated cells. (Magnification greater than in other figures.)
- FIG. 5. A lesion showing the effect of excoriation of the affected area. A minute portion of the epidermis is necrotic, and is included in a small crust. The nettling hair does not appear, and has probably been rubbed away. There is considerable cellular exudation into the subjacent corium.



cuticle is studded. (See Plate, Fig. 3.) The sockets are rather closely set, but usually not in actual contact one with another. The number of nettling hairs to each socket varies within wide limits; some sockets hold but three, while others hold as many as twenty. Beneath the areas upon which the nettling hairs develop the epidermis is modified, and is represented by a large mass of cells. These cells are long and fusiform, with their long axes perpendicular to the surface of the cuticle. The nucleus in each cell is nearer the extremity away from the surface, and the major portion of the cytoplasm is in the form of a long process, which extends into the socket which holds the nettling hairs. Whether these groups of cells are of the nature of poison glands, or simply the formative cells of this type of hair, has not been determined. There is nothing distinctive as regards the microchemical affinities of these cells when compared with cells at the base of the coarse hairs. On the other hand, the granular material within the nettling hairs simulates very closely that found within the coarse hairs, notwithstanding that one is poisonous and the other not. The homogeneous cuticular layer is continuous over every part of the sockets, so that there is no apparent communication between the cells on the interior and the points of the nettling hairs. The significance of the collections of cells beneath the areas bearing the nettling hairs might be understood if stages could be obtained in which these hairs were in the process of development.

There has been considerable conjecture as to whether the dermatitis is due to the mechanical action of the nettling hairs or to a poisonous substance conveyed by them. Fernald and Kirkland submitted material consisting of hairs, cocoons, and molted skins to Mr. F. J. Smith, chemist of the gypsy moth committee. His notes are as follows:—

I made a number of extracts of the hairs with each of the reagents mentioned below, some of the extracts being of the hairs alone, others of the molted skins, and still others of the cocoons which contained hairs in great numbers. The reagents used were: water, alcohol, ether, chloroform, petroleum ether, acetone, acetic ether, dilute sulphuric acid, dilute caustic potash. I tested each of the extracts after digesting for some hours, and in each case they nettled the skin. On the other hand, the *filtered* extracts (freed from hairs) caused no irritation of any sort when applied even where the skin was broken. Careful chemical tests failed to show the presence of any organic acids or alkaloids. Hence I am led to believe that the irritation is of a mechanical nature, caused by the brittle, finely barbed hairs, and not due to a toxic principle.

This analysis would indicate that the action of the nettling hair is a purely mechanical one. These results, however, appeared far from conclusive when the degree of the reaction in the tissue around these extremely minute elements was considered. In order to follow up this question, controls of the nature of purely mechanical agents were sought. Fine glass wool was comminuted between two glass slides, and then rubbed

upon a small area of the skin of the upper arm. This was followed by the appearance of numerous minute red spots. There was a slight soreness over this area, suggestive of the presence of minute foreign bodies in the skin. The red spots persisted for twenty-four hours or more.

The tufts on the back of a tussock moth caterpillar (*Orgyia leucostigma*) were examined, and found to consist of long, sharp-pointed hairs, with sharp barbs projecting at intervals along their entire length. These hairs were of the same general type as the nettling hairs of the brown-tail moth, but were many times as long. When such hairs from the tussock moth caterpillar were rubbed upon the skin, several minute reddish points appeared. There was a barely perceptible prickling sensation, but no itching. Another person inoculated in a similar manner showed no lesion whatever. Thus neither finely comminuted glass wool nor the sharp-pointed, barbed hairs of a tussock moth caterpillar when rubbed into the skin produced any process resembling in character the brown-tail moth dermatitis.

At this time the accidental discovery of a peculiar reaction, which takes place when the nettling hairs of the brown-tail moth are mingled with blood, indicated the presence of a soluble chemical substance in connection with them. If a number of nettling hairs are placed in a drop of blood between a slide and cover glass, an immediate change takes place in the red blood corpuscles. They at once become coarsely crenated, and the rouleaux are broken up in the vicinity of the hair. The corpuscles decrease in size, the coarse crenations are transformed into slender spines which rapidly disappear, leaving the corpuscles in the form of spheres, the light refraction of which contrasts them sharply with the normal corpuscles. The change of form, in addition to a slight shrinkage, causes the red blood corpuscles to appear much smaller than normal. This reaction takes place so rapidly when the fresh, active nettling hairs are used, that the eye can not follow its various stages. However, by treating these hairs in various ways the time of this reaction may be retarded so that all stages of transformation may be seen. The reaction always begins at the basal sharp point of the hair. It was thought that this might possibly be a purely physical phenomenon, but this is disproved in various ways. A variety of minute foreign bodies were mingled with the blood in a similar manner. Such material as minute particles of glass wool, the barbed hairs of the caterpillar of a tussock moth and the other coarser hairs of the brown-tail all failed to produce any effect on the red blood corpuscles.

The next step was to determine whether the nettling hairs could be inactivated by heating. After baking for one hour at 100° C., they gave a typical reaction with red blood corpuscles, and produced a dermatitis when rubbed upon the skin. Baked for one hour at 110° C., they still gave the typical reaction with red blood corpuscles, and produced a typical dermatitis when rubbed upon the skin. However, after being baked an hour at 115° C., the nettling hairs no longer affected

the red blood corpuscles, and when even rubbed into the skin now failed to produce a typical dermatitis, but only a slight redness, which was scarcely discernible, and which was probably comparable with that produced by the penetration of the epidermis by minute foreign bodies, such as particles of glass or the barbed hairs of other caterpillars. The degree of heating does not, in this instance, affect the structural integrity of the nettling hairs, for they appear unchanged even after baking an hour at 150° C.

The experiment of heating the nettling hairs at various temperatures proves conclusively that their action upon the skin is not purely a *mechanical* one, but that it depends upon the presence of a chemical substance which is destroyed at high temperatures. The failure of the nettling hairs, after being heated to 115° C., to give the characteristic reaction with red blood corpuscles, together with the fact that they no longer produce the typical dermatitis, suggested the possibility that this peculiar reaction might serve as an index to their toxicity. This was put to the test in subsequent experiments, and this inference has been borne out.

In order to determine the solubility of the irritating substance conveyed by the nettling hairs, the effect of various solvents was tried both at room temperature and heated. For the time being the presence of the poison in the solvent was disregarded, and the reaction of the nettling hairs with the red blood corpuscles and upon the skin was determined after they had been placed under the influence of the solvent. By so doing it was believed that it would be possible to estimate at least the relative degrees of solubility of the irritating substance.

Treated with alcohol, acetone, chloroform and ether, the nettling hairs remained active both as regards the test with red blood corpuscles and the inoculation of the skin, whether boiled for a short time or kept for days at room temperature. The nettling hairs remained active after being boiled in pyridin, which boils at a temperature between 106° and 108° C. Kept in pure glycerine or in equal parts of glycerine and distilled water for several days, the nettling hairs remained active. They were also active after heating at 110° C. in pure glycerine, but after heating at 115° C. they failed to react. As this was the approximate temperature at which they were inactivated by dry heat, it seems certain that the poison is destroyed at this temperature. The nettling hairs also remained active when kept for several days in glacial acetic acid, in 1/2 per cent. acetic, and in both 1 per cent. and 1/10 per cent. aqueous solutions of hydrochloric acid. The reaction with the red blood corpuscles was delayed for a short time after the soaking in acids, but afterward went on undiminished. This retarding of the reaction is probably due to the fact that several moments must elapse before the acidity of the hairs is neutralized by the blood in which they were placed. The retardation is more pronounced after strong than after weak acid solutions, but if the hairs are subsequently thoroughly washed

in water there is no slowing of their reaction with the red blood corpuscles.

In distilled water the nettling hairs remained active after a period of eighteen days, even though during this time they were centrifugalized and washed several times, in addition to being placed in the incubator at 38° C. for sixteen hours. When warmed in distilled water to 50° C. they were still active, but when warmed to 60° C. they immediately failed to react. Since the substance which gives the reaction withstands much higher temperatures, it seems reasonably certain that it is dissolved out in water raised to this temperature.

Inasmuch as the poisonous substance was evidently soluble in fluid blood at room temperature, it seemed plausible that it might be soluble in dilute alkaline solutions. This was found to be the case. Both 1 per cent. and $\frac{1}{10}$ per cent. solutions of potassium hydrate and sodium hydrate in distilled water were used. The nettling hairs, after remaining over night in these solutions at room temperature, failed to act either on the skin or on the red blood corpuscles.

From these data it seems necessary to conclude that the nettling hairs possess a substance which acts as an irritant to tissues (epidermis) which is relatively stable, being destroyed by heating at the temperature of 115° C. or over, and which is quite soluble in dilute alkalis at room temperature or in water warmed to 60° C. I have been unable to demonstrate whether this substance is located within the nettling hair, or carried upon the surface at its point. If it is true that the wall of the nettling hair is perforated at this point, as indicated by the penetration of staining fluids, it seems not unlikely that the poisonous substance is contained within the chitinous walls. This is borne out by the activity of these hairs after soaking two and a half weeks at room temperature in water, — a reagent which is known to be a solvent when raised to 60° C., — for it seems improbable that so small an amount of the irritating substance, as there must necessarily be, could remain undissolved for this length of time if smeared on the surface of the hair. Furthermore, the specific reaction with the red blood corpuscles always begins at the point of the hairs, except in instances in which they are broken, when the reaction takes place rapidly about the point of fracture. If the irritating substance was secreted, as certain observers have believed, by the two retractile tubercles on the hinder segments, and smeared by the movements of the caterpillar over its hairs, the coarse hairs also would have nettling properties, and react with the red blood corpuscles; but such is not the case. It is probable that the protection afforded the irritating substance by its inclusion within chitinous walled tubes and also its chemical stability account for the fact that the nettling hairs remain active for long periods of time, unaffected by natural influences, such as fluctuations of temperature or repeated wetting and drying.

Since it was impossible to obtain caterpillars in sufficiently large num-

bers for an exhaustive study into the chemical nature of the irritating substance, a preliminary analysis of the material at hand was kindly undertaken by Dr. Carl D. Alsbury of the department of biochemistry, Harvard Medical School. His notes are as follows:—

An extract of all the hairs furnished me was made in distilled water at 60° C. It was faintly clouded and slightly tinged brown. It gave no Millon or Biuret reaction, and could not, therefore, have contained any appreciable quantity of proteid. It showed no coagulation on heating. Its reaction was slightly acid. With saturated aqueous picric acid it gave a fine, not very abundant granular precipitate. With a 25 per cent. solution of phosphotungstic acid in 5 per cent. sulphuric acid there was an abundant heavy precipitate, which formed gradually. With tannic acid there was an abundant brown flocculent precipitate. Silver nitrate caused a slight brown precipitate. Potassium mercuric iodide, barium chloride and mercuric chloride merely produced turbidity. The solution did not reduce Fehling's solution either before or after boiling with dilute mineral acid. As the quantity of material used in the last two tests was very small, the results must be taken as provisional. The small quantity of material available, moreover, made it impossible to test the toxic action of the precipitates formed by the various reagents. There is, therefore, no guarantee that the substance or substances precipitated by phosphotungstic acid, etc., actually are the active principle.

The difficulties in the isolation of a chemical substance of this nature are great, and this undertaking has been deferred until another season, when it may be possible to obtain material in sufficient amount with which to work advantageously. In making extracts from the nettling hairs, other substances besides the irritating principle will probably be found, which will have to be eliminated. In this instance the biological test will undoubtedly be of value.

The possibility of the occurrence within the body of the caterpillar of an irritating substance identical with that found in the nettling hairs has been considered. If a brown-tail caterpillar be laid open, and precautions are taken not to introduce any nettling hairs into its tissue, its fluids will be found to be highly poisonous if placed on a slight excoriation of the skin. The part commences to itch at once, and the skin becomes elevated, white and edematous, and a large wheal develops. The lesion has a well-defined, abrupt edge, and spreads for a radius of one centimeter or more about the scratch. A reddish petechial flush appears over a wide area of skin about the wheal. At one-half or three-quarters of an hour after the inoculation the process is at its height, and after an hour the border of the lesion is not so sharply defined. The edema subsides gradually, giving place to diffuse redness, and the skin over this area feels slightly sore for several hours. In this manner the fluids of the caterpillar may be demonstrated to be poisonous, but the irritation is due to a substance quite different from that found in

the nettling hair. This is proved by the failure of the fluid from the caterpillar to produce, when mingled with mammalian blood, any characteristic change in the red blood corpuscles. The reaction of the human skin in this instance is much more severe, but, on the other hand, is of much shorter duration than is the case of the lesions produced by the nettling hairs. It is possible that the fluids of other caterpillars, usually regarded as innocuous, would be found equally poisonous if rubbed into excoriations of the skin; but this was not tried.

The pathological processes produced by the nettling hairs of the brown-tail moth were studied in both human and animal tissues.

The reaction of the human skin to the nettling hairs of the brown-tail moth varies greatly with different individuals. When these hairs are rubbed upon the skin, there is immediately, with most persons, considerable itching, and the inoculated area rises up in the course of fifteen or twenty minutes in the form of a wheal, about which there is considerable reddening, that changes to white when the skin is stretched. The reaction, however, is not always so prompt to appear. The severest process observed showed nothing for a period of eight hours after the inoculation. The nettling hairs, even when rubbed into the skin of other individuals, produce only slight reddening or perhaps very slight elevation, and practically no discomfort. Whether or not decreased alkalinity of the blood forms a factor in the insusceptibility of these persons is only a matter of conjecture. The blood of all persons and of all laboratory animals thus far tried has reacted in a typical manner to the nettling hairs. ,

The dermatitis as it occurs naturally is of two types, according to the manner of acquisition. If, for instance, a caterpillar is felt crawling over one's neck and is thereupon slapped or crushed and the part afterward thoroughly rubbed and scratched, a marked local dermatitis develops, in which the lesions are confluent. There is a local reddening and thickening of the skin, with the formation of papules or vesicles, as the case may be. A patient in this condition is liable to seek the advice of a physician. On the other hand, if the nettling hairs are distributed by a breeze to underclothes as they hang drying, the dermatitis which results from wearing these clothes is of the nature of a scattered urticarial rash. The lesions in such a case are in the form of small discrete papules, which, if not scratched, often show at their summit a tiny vesicle filled with clear fluid. They are generally more numerous on parts of the body where the skin is soft. Many persons having such rashes never consult the physician. Warm, muggy weather aggravates the condition; the reason for this is that the epidermis is then kept moist by perspiration, and, becoming softer, favors the penetration of the nettling hairs. In dry, cool weather the epidermis is less easily penetrated.

The duration of this form of dermatitis may be long, on account of repeated inoculations; the individual lesions usually, however, heal in

from a week to ten days. The severe localized form of dermatitis is perhaps more prevalent in May and June, as it is then that the caterpillars are reaching their maturity. The form of dermatitis in which the rash is scattered is common when the moths are flying in large numbers (July), as well as earlier, in the season of the caterpillars. A dermatitis may be acquired at any season of the year by the handling of large numbers of nests or cocoons. The wearing of an undergarment which had been packed away a year since its contamination with nettling hairs has often been sufficient to produce dermatitis.

The material on which the histological study of the dermatitis is based consists in part of a piece of skin excised from the upper arm of the author twenty hours after inoculation with the nettling hairs of a caterpillar collected early in March. The tissue after fixation in Zenker's fluid was imbedded in paraffin and serial sections made. Without serial sections it would be difficult, except perhaps by accident, to find the nettling hairs in the tissue. Material for supplementary study was furnished by lesions produced experimentally in animals.

The lesions in the human skin may be summed up as follows. The nettling hairs are found imbedded at various depths; some penetrating in a direction oblique to the surface are situated superficially in the epidermis, others have penetrated the entire thickness of the epidermis, and others have passed through the epidermis and have penetrated the corium for nearly their entire length. There is necrosis of the epidermis around the nettling hair, and in most instances there is exudation of fluid into the epidermis, so that a tiny vesicle is formed. The contents of the vesicle consists of clear fluid, in which are disintegrating epithelial cells, a few large mononuclear cells (phagocytes), and numerous eosinophiles, which in many instances are completely disintegrated. The latter cells are found constantly, and appear to be the earliest cells to invade the epidermis about the foreign hair. Many occur with irregular pseudopodia-like processes, as though fixed when in amœboid motion. The disintegration of these cells forms masses of eosin staining granules, which are found in the spaces in the epidermis. In certain instances the space in the epidermis occupied by the exudate appears continuous, with a dilated lymphatic. There is marked inflammatory reaction in the corium, as shown by the presence of large collections of cells about the blood vessels. These collections of cells consist of large mononuclear (or transitional) cells which are often phagocytic, of lymphoid cells, and of numerous eosinophiles. An occasional polynuclear leucocyte is found.

Thus the process in the human skin consists of the penetration of the nettling hairs into or through the epidermis, the necrosis of contiguous epidermal cells, and exudation into the epidermis, a constant element in which are numbers of eosinophile cells. There is undoubtedly local congestion and edema of the corium, but this did not appear to any marked degree in the sections studied.

As the amount of inoculable material at hand was small, but few animal inoculations were performed. Mice were inoculated subcutaneously and intraperitoneally with both active nettling hairs and nettling hairs inactivated by soaking in a dilute solution of an alkali. The nettling hairs were made practically sterile by boiling for ten minutes in strong alcohol, — a process which does not destroy their specific action, — and then suspended in a .6 per cent. solution of sodium chloride. Probably on account of the tendency of the fresh, active nettling hairs to rise to the surface of the suspension fluid, only a small number were injected, for they were found with difficulty in the tissue. The inactivated nettling hairs, on the other hand, were evenly distributed in the suspension, and were found in the tissue in large numbers. Some of the mice, more especially those receiving the active nettling hairs, showed evidence of intense itching of the skin at the site of inoculation. Fifteen hours after the inoculation, a slight subcutaneous swelling, more marked in certain of the mice which had been inoculated with active nettling hairs, was distinguishable.

A mouse killed twenty-four hours after inoculation with active nettling hairs showed an ill-defined, pinkish-tinged area of subcutaneous edema at the site of injection. Stained sections of this area show skin as well as subcutaneous tissue distended with fluid exudate. Large numbers of polynuclear leucocytes are present, scattered through the tissue. No nettling hairs are present in that portion of the lesion from which the sections are taken. The peritoneum presented no gross lesion. Stained preparations of the mesentery show numerous minute inflammatory foci, consisting of aggregations of phagocytic cells, intermingled with lymphoid cells. There is also a small number of polynuclear leucocytes scattered through the mesentery. The nettling hairs are often apparent within these foci of inflammation.

A mouse killed twenty-four hours after inoculation with the inactivated nettling hairs presented a small, well-defined, dull reddish area on the inner aspect of the skin at the site of inoculation. Sections of this lesion show enormous numbers of nettling hairs imbedded at about the level of the superficial muscle layer, the fibers of which are here either degenerating or necrotic. Some fibers are actually pierced by the hairs. In the immediate vicinity of the injury are large numbers of polynuclear leucocytes, many of which are disintegrated. There is practically no distension of the surrounding tissue with fluid. On the peritoneum of this mouse were several minute whitish flecks, apparent to the naked eye. The histological study of the mesentery and omentum reveals very numerous foci of inflammation of the same general character as those found in the mouse inoculated with the active nettling hairs. These inflammatory areas consist chiefly of collections of phagocytic cells grouped about the nettling hairs. Lymphoid cells are not so numerous as in the lesions of the mesentery in the preceding case.

In mice killed forty-eight hours after the inoculation the subcutaneous lesions were scarcely distinguishable, and, on account of the diffi-

culty of orientation, the sections made did not pass through the lesions. The mesenteries, in addition to the cells already described, show numerous stellate cells, probably fibroblasts.

The results of these few animal inoculations show clearly one point of difference between the lesions produced by the active nettling hairs and the lesions produced by those which have been inactivated. The lesion produced by the subcutaneous inoculation of the active nettling hairs shows a much greater amount of fluid exudate than is the case in the lesion produced by inactivated nettling hairs. This fact tends to support the view that the action of the nettling hairs is not purely a mechanical one.

SUMMARY AND CONCLUSIONS.

The most important facts thus far ascertained concerning the brown-tail moth dermatitis may be summarized as follows:—

The lesions are produced by the penetration into the epidermis of peculiarly modified microscopic hairs, the nettling hairs, which are sharply pointed and barbed for their entire length. The other hairs of both the caterpillar and the moth do not produce any dermatitis. These nettling hairs develop on the caterpillar, but are also found, as the result of direct transference, on the cocoons, moths, egg masses, and in the winter webs, and are blown about in the air. They develop on the subdorsal tubercles of the fifth and sixth segments of the young caterpillars, but are much more numerous as the caterpillars attain their growth, being then found on the subdorsal and lateral tubercles from the fifth to the twelfth segment inclusive. The caterpillars are then very poisonous.

The nettling hairs, which from their shape are perfectly adapted for penetration, possess in addition an irritating substance, which is undoubtedly an important factor in the production of the dermatitis.

This substance may be destroyed by heating the nettling hairs at 115° C. either in a fluid or with dry heat, or it may be extracted from them by certain solvents, such as dilute solutions of alkalies at room temperature, or water heated to 60° C. Nettling hairs inactivated by either of these measures produce no more than a slight redness when rubbed into the skin, and probably act then merely as foreign bodies.

An index for the presence of the irritating substance is found in a peculiar reaction which takes place when the active nettling hairs are mingled with a drop of blood between a slide and cover-glass. This reaction begins about the point of the hair, but spreads rapidly, so that a large area is involved. The first change is the breaking up of the rouleaux of red blood corpuscles. The corpuscles then become coarsely crenated; later are spherical, with slender spines protruding from the surface; and finally appear perfectly spherical and closely packed. If the irritating substance has been previously either inactivated by heat or extracted from the nettling hairs, they no longer give this reaction with the red blood corpuscles.

The dermatitis produced by the nettling hairs is of two types, dependent upon the number of these elements penetrating a given area. The severe type is usually due to actual contact with caterpillars; the milder scattered rash is due to nettling hairs blown in the air and lodging on the skin or on the undergarments as they hang drying. The pathological process in the skin consists of necrosis of the epidermal cells around the nettling hairs, the formation of spaces or microscopic vesicles in the epidermis at the site of injury, and in inflammatory changes about the vessels of the corium.

Mice inoculated with active nettling hairs present lesions characterized by a large amount of fluid exudate, while those inoculated with inactivated nettling hairs show inflammation of the nature of a reaction due to the mechanical injury brought about by these elements.

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RECOMMENDATIONS.

The work against the moths has gone far enough to show that we have in the present law a practical means of suppressing these dangerous insects when effective co-operation can be secured. Such being the case, if the effort is to be continued, the law should now be so amended as to make it general in its provisions, and applying to all future operations against the moths until they are brought under control. To this end, instead of taking as a basis of assessments and liabilities under the law the valuations of 1904, the superintendent recommends that the valuations of the previous year be taken as such basis in each succeeding year.

The superintendent should be given authority, subject to the approval of the Governor, to initiate or carry on necessary work against the moths in cities or towns failing to provide sufficient funds in season for such necessary work, or failing to perform it in a satisfactory manner; the work so done to be at the expense of the city or town, which shall be collected in the form of a special State tax upon municipalities failing to comply with the requirements of the law. This, of course, will necessitate an extra amount of expert supervision on the part of the central office, and a suitable charge for State management may properly be made. Should this recommendation be adopted, a proper allowance should be made, as under the statute, for the cost of all work done directly by the city or town during the year when said operations were in progress.

In the case of local parks, cemeteries, woodlands and other places of general public resort, where there is particular danger of the scattering of the moths, the superintendent should be given authority to take charge, at the expense of the State, of the necessary field operations, or to assist cities and towns in carrying on the same, subject to the approval of the Governor. If this recommendation is adopted, the central office will be legally in a position to give additional assistance to those municipalities which might otherwise be obliged, from lack of funds, to neglect the proper care of their parks and similar places of public resort.

To avoid as far as possible the frequent delays in prosecuting the work contingent upon lack of suitable appropriations, the superintendent recommends that reimbursements to all cities and towns be made every sixty days.

To enable this office to close properly its accounts with the various cities and towns in season to complete the financial statement and report, as required by law, the superintendent recommends that the fiscal year end hereafter on December 1, instead of January 1, as at present.

As the situation with regard to the residential districts and roads is now well in hand, suitable provision for the vigorous prosecution of work against the moths in woodlands also should be made. Each year of neglect will greatly increase the ultimate cost of such operations, and to enable us to make a beginning in the work in the infested woodlands, as well as to hold the ground gained in residential districts, an additional appropriation of at least \$225,000 should be made.

While sufficient funds are probably available for the necessary investigation of parasites during 1907, it is desirable that an additional appropriation of at least \$10,000 be made for the work of 1908, so that there may be no interruption in prosecuting this important investigation during the early months of that year.

The superintendent is earnestly of the opinion that it will be the part of wisdom, as well as sound business policy, to provide suitable funds for the field work as well as the study of parasites, not only during 1907, but for a period of at least three years, so that the work may be continued without interruption, and that there may be no loss of trained employees and of ground gained.

Respectfully submitted,

A. H. KIRKLAND,
Superintendent.

